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Proceedings: National Workshop on Pesticide Waste Disposal
Denver, Colorado, January 27-29, 1986

JACA Corp., Fort Washington, PA

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16. ABSTRACT

A national workshop on the dispos[illegible]esticide wastes was held in Denver, Colorado on January 27-29, 1986. The purpose of [illegible]orkshop was to work with government, pesticide user groups, pesticide producer[illegible]m organizations, and academia to define and offer practical solutions to pesticide users' disposal problems.

This publication is a compilation of the speakers' papers and transcripts of the summary panels. The following topics are covered: industry's role in users' waste disposal, on-site demonstration projects, regulatory update, summary of pesticide research workshop, users' waste minimization/reuse, users' waste treatment/storage/disposal, and summary panels on technology, regulations, and application of pesticides.

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Denver, Colorado, January 27-29, 1986

by

JACA Corp.
Fort Washington, Pennsylvania 19034

Contract No. 68-03-3252

Project Officer

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Office of Program Operations
Hazardous Waste Engineering Research Laboratory
Cincinnati, OH 45268

HAZARDOUS WASTE ENGINEERING RESEARCH LABORATORY
WATER ENGINEERING RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

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DISCLAIMER

The following papers have been reviewed in accordance with the U. S. Environmental Protection Agency's peer and administrative review policies and approved for presentation and publication:

Pesticide Research Workshop Summary
Dealing with Emergencies
On-Site Disposal-RCRA Options

The following papers describe work that has not been funded by the U. S. Environmental Protection Agency and therefore the contents do not necessarily reflect the views of the Agency and no official endorsement should be inferred.

Summary of 1985 Workshop
Industry's Role in Users' Waste Disposal
Carbon Adsorption Treatment of Rinsewater
Treatment of Pesticide Containing Soils
Biological Treatment of Waste Disposal Site
Exploitation of a Biological Process in the Eliminating of Cattle-Dip Pesticide Wastes
Biological and Chemical Disposal Systems for Waste Pesticide Solutions
Minimization Technology
Collection and Containment
Pesticide Rinsewater Recycling Systems
Product Storage and Handling Equipment
Reconditioning Containers
Recycling of Plastic Containers
Off-Site Disposal of Pesticides and Pesticide Containers

The panel discussions of January 29, 1986 were taped and transcribed and have become part of these Proceedings. We were unable to obtain edited copy from Raymond F. Krueger and O. R. Ehart who were part of the Regulatory Summary Panel and Richard Byer who was part of the Users' Summary Panel within the available time that was scheduled for this task. It is therefore noted that these unedited and edited remarks are accepted as an important portion of the Proceedings but do not necessarily reflect the views of the Agency nor should any official endorsement be inferred.

FOREWORD

The U. S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water systems. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. The Clean Water Act, the Safe Drinking Water Act, the Resource Conservation and Recovery Act, the Federal Insecticide, Fungicide and Rodenticide Act, and the Toxic Substances Control Act are five of the major congressional laws that provide the framework for restoring and maintaining the integrity of our Nation's water, for preserving and enhancing the water we drink, and for protecting the environment from hazardous and toxic substances. These laws direct the EPA to perform research to define our environmental problems, measure the impacts, and search for solutions.

The Water Engineering Research Laboratory is that component of EPA's Research and Development Program concerned with preventing, treating, and managing municipal and industrial wastewater discharges; establishing practices to control and remove contaminants from drinking water and to prevent its deterioration during storage and distribution; and assessing the nature and controllability of releases of toxic substances to the air, water, and land from manufacturing processes and subsequent product uses. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

The 1986 National Workshop on the Disposal of Pesticide Wastes was an outgrowth of the Workshop held in 1985 which was developed to provide a national forum that assembled pesticide users, pesticide producers, federal and state agencies and agricultural and environmental researchers to collectively address the complex issues of pesticide waste disposal and serve as a basis for continued dialogue and interaction. The Office of Research and Development with the Office of Pesticide Programs and Office of Solid Waste sponsored the development of these Proceedings to document the conduct of this solution-oriented workshop. It is hoped that the content of these Proceedings will continue to stimulate action to reduce pollution by illustrating approaches and techniques highlighted by the excellent papers presented at the workshop.

Francis T. Mayo, Director
Water Engineering Research Laboratory

ABSTRACT

A national workshop on the disposal of pesticide wastes was held in Denver, Colorado on January 27-29, 1986. The purpose of this workshop was to work with government, pesticide user groups, pesticide producers, farm organizations, and academia to define and offer practical solutions to pesticide users' disposal problems.

This publication is a compilation of the speakers' papers and transcripts of the summary panels. The following topics are covered: industry's role in users' waste disposal, on-site demonstration projects, regulatory update, summary of pesticide research workshop, users' waste minimization/reuse, users' waste treatment/storage/disposal, and summary panels on technology, regulations, and application of pesticides.

This report was submitted in partial fulfillment of Contract No. 68-03-3252 by the JACA Corporation under the sponsorship of the U. S. Environmental Protection Agency. This report covers the period October 1985 to July 1986; work was completed as of June 30, 1986.

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American Chemical Society (Division of Agrochemicals)
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National Agricultural Aviation Association
National Agricultural Chemicals Association
National Alliance of Independent Crop Consultants
National Barrel and Drum Association
National Forest Products Association
National Pest Control Association
U. S. Department of Agriculture (Soil Conservation Service, and Science and Education: Cooperative State Research Service, Extension Service, and Agricultural Research Service)
U. S. Environmental Protection Agency (Office of Pesticide Programs, Office of Research and Development, Office of Solid Waste)

A special note of appreciation is extended to Mr. Roy R. Detweiler, Chairperson of the Workshop Coordinating Committee and Mr. Thomas J. Gilding, Workshop Coordinator. Also many thanks are given to Ms. Sherry Cramer and Ms. Marilyn McKinnis for all their contributions in making sure the Workshop ran smoothly. These individuals along with the members of the Workshop Coordinating Committee worked diligently to make this 1986 National Workshop on Pesticide Waste Disposal a success.

PROGRAM

National Workshop on
Pesticide Wastes Disposal

Clarion Hotel -- Denver, Colorado
January 27-29, 1986

Roy Detweiler, Workshop Moderator

Opening Remarks

Welcome and Introduction

Keynote Address

Pesticide Waste Disposal: Review and 1985 National Workshop Summary

Industry's Role in Users' Waste Disposal

On-site Demonstration Projects Reports

- Carbon Adsorption Treatment of Rinsewater
- Treatment of Pesticide-Containing Soils
- Biological Treatment of Waste Disposal Sites
- A Biological/Physical Process for the Elimination of Cattle-Dip Pesticide Wastes
- Biological and Chemical Disposal Systems for Waste Pesticide Solutions

Regulatory Update

- FIFRA
- RCRA
- Regional Perspectives

Pesticide Research Workshop Summary

Users' Waste Minimization/Reuse

- Rinsewater Management:
  - Direct Injection as a Rinsewater Minimization Technology
  - Waste Water Recycling
  - Recycling Pesticide Rinsewater
- Tanks and Fittings for Fluid Fertilizers, Pesticides and other Liquid Products Related to Agriculture
- Dealing with Emergencies

Users' Waste Treatment/Storage Disposal

- Container Management:
  - Reconditioning Containers
  - Recycling Metal Containers
  - Disposal of 55-Gallon-All-Plastic Drums
  - Resource Conservation and Recovery Act (RCRA) Permitting of an On-Site Pesticide Waste Storage and Treatment
  - Off-Site Disposal of Pesticides and Pesticide Containers
- Storage, Handling and Shipment of Pesticide Waste-Regulatory Requirements

Summary Panels

Opening Comments

- Technology Summary Panel
- Regulatory Summary Panel
- Users' Summary Panel

Posters and Exhibits

KEYNOTE ADDRESS

Robert Wayland

U S Environmental Protection Agency

Washington, D. C.

Robert Wayland is a Special Assistant to the EPA Administrator in Washington. He is a policy advisor to Lee Thomas on Hazardous Wastes and Office of Water activities. He has worked with EPA since 1974, has been a director for the Office of Legal and Enforcement Policies, a director of Policy and External Affairs, in the Office of Solid Waste and Emergency Response, and prior to that he was a staffer in both the House of Representatives and the U. S. Senate.

When I talked with Marcia Williams at 5:30 p.m. Friday, and she told me she was going to have to throw in the towel and would not be able to make the conference she asked me to be sure and emphasize to all of you just how disappointed she was. As a former Deputy Assistant Administrator for Pesticides and Toxic Substances and now Director of the Office of Solid Waste, her job experience, like mine to a degree, very much involves all of the aspects of the issues under discussion today. So we hope that Marsha will recover soon and also that she will be able to follow through on many of the directions that I hope will be set today.

As many of you know EPA just recently marked the 15th anniversary of the Agency's creation and this milestone naturally has been a time of reflection to mark where we have been and to set a course for the future. Jim Barnes, Deputy Administrator, with whom I work most closely, is fond of recalling that when he first came to the agency in 1970, and it moved to its headquarters at Waterside Mall, there were signs just two blocks from the building that warned people not to swim, not to fish in the Potomac river. The other afternoon we were in Jim's office talking about some momentous matter or another and for one reason or another we were all staring out the window and there were wind surfers on the river. They got into the water, as wind surfers often do, and we all remarked that at least they would not have to get tetanus shots.

In 1970 the continued existence of our national symbol was threatened. Now the bald eagle is coming back strong. There have been some very tangible indications of progress that we can look out our windows or take a trip to Alaska to see but just as we have made important progress there are some very difficult problems that remain. In some respects we have used the knowledge that we have accumulated over the last 15 years to redefine what is or isn't the problem. Now at EPA today we have more legal tools than we did in 1970. When the Agency was established there was no RCRA, no TSCA, no Superfund law. The state of technical and scientific knowledge has increased immensely. Our ability to evaluate the toxicity of the substances we work with has improved and analytical methods are much more advanced than they were, allowing us to measure ever smaller and smaller quantities of contaminants which pose new challenges to policy makers. There are more pollutants of concern, not so much because they are new pollutants but because we did not know enough to be concerned or we did not know that they were there at all.

We tended, in the beginning, to put our regulatory programs into boxes. In our early years EPA worked hardest to control the largest and most obvious sources of pollution. With the visible pollutors and pollution under control we face difficult policy and institutional problems. Designing controls and summoning the will to control a belching steel mill is a far different proposition from regulating tens of thousands of drycleaning plants whose individual solvent emissions contribute to nonattainment of primary ozone standards in many areas of the country and subject hundreds of thousands of people to unhealthy air.

In the 1970's we worried about hydrocarbons, Co, Nox, particulates, in our air program. Water worried about suspended solids and the biological oxygen demand. The so-called conventional pollutants. In the 1980's all of our media worry about specific metals and a large number of organic chemicals.

When the agency was established there were important resources, notably ground water, not addressed at all in our legal mandate or anywhere in our organizational structure. We simply did not understand their value or their vulnerability.

Today we have become increasingly able to recognize that the same compounds that are used for products, pesticides fertilizers, other chemicals that we depend on to maintain our lifestyle, can, in certain circumstances, cause problems for human health and the environment. In other words, pollutants are not just undesirable by-products of society, the same compounds can cause unintended effects during their manufacture, disposal, and even during use. So as I said we have begun to redefine the problem.

We have also discovered that fixing one problem may cause a different problem. Reducing workplace exposures to carcinogens through better ventilation, for example in the case of ethylene oxide, a common hospital disinfectant, or other solvents, simply releases the substance into the ambient air and we have begun to appreciate that we have a significant air toxics problem in the country.

Incinerating solid and liquid hazardous waste as fuels in industrial boilers may result in ambient air pollution with metals. Cancelling one pesticide may shift people to a substitute which present other and possibly greater environmental or health problems. The simple boxes into which we categorized our problems in the early going has tended to cause a lot of anomalies which sometimes make a good story for Jack Anderson and that often make real people shake their heads. Manufacturing smoke stacks are unregulated for many metals and organics, yet the incinerators that burn hazardous waste are highly regulated. The ambient air and the people who breathe it really do not know the difference. Ground water monitoring acceptable for cleaning up the Superfund site is not adequate under our rules for operating a RCRA facility. Transportation of hazardous waste are manifested and carefully controlled but there are not equal and equivalent controls for transportation of much more hazardous chemical products.

Existing pesticides and chemicals continue in use without fully adequate data on some health or environmental effects and the burden is on the government to prove harm, which is a long term process. New, safer pesticides and chemicals are held to a higher standard. Some may not pass initally, all must be supported by substantial evidence of safety. Many pesticides and fertilizers can be used as products and placed on the ground with limited restriction. These same compounds may soon be banned from land disposal in high technology landfills even at the most dilute concentrations.

What is the solution? There are some that suggest that one solution is for Congress to scrap the 14 or so environmental laws under which we presently operate and develop holistic, organic EPA statutes. In fact, Bill Ruckelshaus made such a proposal, shortly after his return to EPA. This seems highly unlikely however. Congress is now considering special groundwater legislation to plug the gap I mentioned earlier and they continue to reauthorize the individual statutes that EPA administers with greater and greater specificity and more and more deadlines.

I think what that leaves us with is the need to make the existing laws work better. One of the ways we hope to do this is by creating a cadre of managers at EPA who appreciate and understand more than one environmental medium. Lee Thomas and Jim Barnes undertook a major shift of senior agency managers last year. It was partly to foster personal growth for the individuals involved but they also knew that somebody who had worked for years to protect air quality was not likely to send a drinking water regulation to the administrator that would simply volatalize the contaminants into the ambient air.

Marcia Williams, who was to be with you today, was one of the beneficiaries of the senior management rotation.

Another emphasis is to undertake more evaluation of "cross media" effects of each regulation as it is developed. That is something I am partly responsible for in the Office of the Administrator.

In addition, I think there is a greater recognition of the limitation of traditional command and control regulatory approaches. EPA is looking toward regulatory negotiation projects with earlier involvement of the regulated community in the development of the proposals we have to manage these problems. In fact, two of the first three regulatory negotiation projects that the Agency has undertaken are under FIFRA. There is a Section 18 rule nearing completion now, emergency exemptions, and we have actively underway a negotiation project for the re-promulgation of EPA farmworker protection standards.

This conference today signals a lot of the positive aspects of the new ways we are hoping to do business with EPA.

First and foremost, we have a recognition here, as we did last year, that both FIFRA and RCRA cover aspects of pesticide waste disposal. The conference is a cooperative venture of government at the state and federal level and the private sector.

Also, I think, this meeting recognizes that research has to play a very important role in deriving solutions for the future, transcending any of the regulatory structures we may have put into place.

I would like to turn to some specifics now, and talk about some joint efforts of the Office of Pesticide Programs and the Office of Solid Waste, the RCRA activities that are largely mandated by amendments adopted in 1984, about which some of you heard last year, and close with some specific opportunities for the pesticide producer and user communities and state officials to work with us to our mutual benefit.

Recently the Office of Solid Waste and the Office of Pesticide programs completed a joint action plan on pesticide disposal. It is comprised of a number of elements which I would like to highlight briefly.

First and foremost of these is a need to better communicate to the regulated community and the regulators recognizing that they come from a variety of state agencies. A series of fact sheets is going to be developed by the end of this year, the first of them are already under preparation, to include topics like: disposal of small quantities of waste, homeowner disposal, reuse and recycling opportunities, container rinsing techniques, disposal of concentrates and undiluted formulations.

The organization represented here, NACA, SFIREG, NAAA, can all assist us by suggesting additional topics for fact sheets that EPA can develop, reviewing the drafts that we prepare--keep us on the straight and narrow--and help us to insure that these materials are widely distributed when they are completed.

A second priority area is the need to develop a more consistent categorization of accutely and chronically toxic pesticides. As you may know there are schemes that have been adopted under both statutes by the two programs to categorize acutely toxic pesticides.

The Office of Solid Waste wants to try to make the FIFRA tox category one, pesticides consistent with those pesticides defined acutely hazardous under RCRA.

The practical consequence of being defined as acutely toxic under RCRA is that the small quantity generator exemption drops from a thousand kilograms to one kilogram. To reconcile these differences, both programs will have to look at the listing criteria they have employed as well as specific pesticides currently listed.

There will also be an effort to develop consistent outcomes with respect to any future actions taken by either program. That is, additions to the so called 261.33 F list, as it is known in RCRA, and the tox categorizations that are assigned to new pesticides under FIFRA.

OSW is going to make sure that all pesticides defined as hazardous under RCRA are accurately listed and reflect all known information. In the past the Office of Solid Waste has been heavily dependent on contractor support and in some instances has not made full use of the toxicity data available in the agencies, filed across the river at Crystal City, that have been submitted by manufacturers to support registrations.

Both programs are going to endeavor to jointly evaluate disposal issues and options pertaining to dilute pesticides: equipment wash water, container rinsates and dilute mixtures.

The key question is really whether or not these rinsates are hazardous. Under RCRA, as the rules stand today, a mixture rule applies which establishes that once mixed with a hazardous waste the resulting mixture is always hazardous, no matter how far down the resulting mixture is diluted. A lot of people questioned whether this really makes sense and it leads to the kind of concerns that John Wells alluded to earlier where pesticides can be applied directly to fields at concentrations far higher than can be disposed in landfills after they have been diluted as a result of rinsing.

OSW indicates that results of the study, which Matt Strauss is going to report on later today, will be used in re-evaluating our regulatory postures.

One final area that both programs are concerned about, is the need to get ahead of the power curve, where biotechnology is concerned. We are just beginning to consider registering the first genetically engineered pesticides and we do not want to find ourselves three to five years from now realizing that little or no consideration was given to how the waste products that may result are to be disposed.

Finally, there are some aspects to the 1984 amendment to RCRA that I want to touch on briefly.

The hazardous and solid waste amendments of 1984 turned RCRA into a very specific statute, and were partly a reaction to what Superfund was uncovering around the country, as we looked at abandoned hazardous waste sites. A lot of loopholes were closed, tight time-frames were imposed on the agency and the regulated communities, and significant attention was placed on groundwater protection and waste minimization.

EPA was directed to do a number of specific things, including undertaking the listing of additional wastes. We have under examination pesticide manufacturing wastes and specific pesticides for future inclusion under the RCRA Subtitle C framework.

In addition, we are re-examining our existing toxicity characteristic test. Wastes are captured under RCRA either because they have been specifically listed by the agency or because they exhibit a characteristic of ignitability, corrosivity, reactivity or what we call EP toxicity. That toxicity is determined through an extraction procedure which is a pretty good basis for evaluating whether something is harmful to groundwater, or so we believe. Analysis of the EP tox test, now involves a very limited number of contaminants and we are considering adding a number of pesticides to the list of things for which analysis has to be performed in the tox test.

We have been directed to lower the small quantity generator exemption, which I referred to earlier, from a thousand to one hundred kilograms and a proposal has already been made. We are looking to final rule by March 31st of this year. We did a number of informational brochures for people who are potentially affected by the small quantity generator being lowered, including one that specifically deals with pesticides.

The Congress has also enacted a land disposal ban provision which basically presumes, unless the agency is able to establish otherwise, that hazardous waste should not be managed in the land.

We have just proposed our decision criteria for determining which wastes would be prohibited from land disposal and many of the hazardous wastes that are generated by firms that are represented here today will very likely be candidates for the ban.

Another significant amendment directs EPA to re-evaluate the criteria by which states regulate solid waste, that is those wastes which do not exhibit one of the characteristics or have not been specifically listed by EPA. There is every possibility that this will result in some tightening of the solid waste disposal requirements, though we are not looking for that until the 1987-1988 time-frame.

I almost overlooked mentioning that we were also given authority in the 1984 amendments to issue research development and demonstration permits, which I think is one of the bright spots as far as those amendments are concerned in that we should be able soon to issue permits on an expedited basis to evaluate promising new technologies.

I would like to close with some thoughts about the challenges that confront all of us in the overall framework that I have mentioned that is specific to the topics that are going to be under discussion today.

The challenges for us at EPA as we develop a regulatory program to protect human health and the environment from mismanagement of hazardous waste is to do so without over-protection. We are going to attempt to do that, in part, by enhancing the coordination among all parts of EPA, including those joint OPP/OSW activities I mentioned.

We are going to endeavor inject risk based decision making into RCRA, a statute that we traditionally implemented in black and white terms. Something is deemed hazardous and is regulated under the full weight of the Subtitle C program or it is not.

We have to ask ourselves, should not we be considering the concentration of the waste and the toxicity of the resulting mixture.

I think there has to be an effort on EPA's part to simplify regulations wherever possible. We have created a very complex and partitioned structure of regulations and as we expand from a universe of 1,500 or so entities regulated under RCRA to over 150,000 we need to appreciate that this complexity may lead to unintentional non-compliance.

EPA needs to focus sooner during the regulatory development process on implementation issues. How are we going to get these regulations to work on the field level, are they practical, are we asking people to undertake analyses that are beyond the reach of the farmer or gas station owner who may be potentially subject to some of these requirements.

I think we have to strive to create an environment of predictability and certainty for regulated community which will allow them to undertake the research and development in new disposal and improved disposal techniques without concern that their efforts would be impeded by an attitude that has sometimes prevailed: if we have not seen it before we can not possibly take a chance on it. We are not so satisfied with present disposal technology that we can afford that kind of attitude.

I think this conference underscores some challenges for our colleagues in the state. First of all there is a need for coordination between the agriculture and FIFRA implementation agencies at the state level and those who implement the solid and hazardous waste laws. The state level is where the implementation really occurs and a better exchange of information is very important.

We are going to depend heavily on our colleagues in the states to help us disseminate information to those who are to be newly regulated and those for whom the regulatory environment is changing rapidly. We are going to rely on states to help provide early input in our regulatory development activities as for example, SFIREG worked on pesticide disposal and groundwater issues.

I see some challenges for pesticide users and producers. You need to help us identify real problems. Some of the problems that we discussed at this meeting last year and that we face today are ones that ought to have been avoided with enough foresight on our part and enough openness in our dialogue.

We are also going to depend on producer and community to help us disseminate information. We want to have your input on the effects of some of our new activities, such as C evaluation. We want you to continue to participate as active players with EPA on the implementation issues associated with pesticide disposal.

That is a pretty substantial menu of challenges. I think this conference does prove a valuable opportunity for us to work together and make us start meeting the challenges.

Thank you very much.

PESTICIDE WASTE DISPOSAL:
REVIEW AND 1985 NATIONAL WORKSHOP SUMMARY

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ABSTRACT

The 1985 National Workshop provided a forum for exchanging ideas ranging across a broad front, from the needs of applicators, through the rationale for and intracacies in regulation, to discussion of some here-and-now practical approaches to disposal as well as more esoteric ones which might become available in the future. The Workshop produced the tangible result of leading directly to a Research Workshop held in Cincinnati just 6 months after the Denver Workshop at which more specific planning occurred along with implementation of some funding of projects. Less tangible results included the stimulation of attendees to a new sense of urgency, and the raising of expectations that solutions to the problem of waste disposal were on the horizon.

INTRODUCTION

A national workshop on the disposal of pesticide wastes was held in Denver, Colorado, on January 28-29, 1985, with approximately 400 persons in attendance. The program consisted of nineteen individual presentations and a summary panel expressing the views of governmental agencies, pesticide user groups, pesticide producers, pesticide consultants, and academia, with the purpose of defining practical solutions to pesticide users disposal problems. In this summary, I will attempt to reiterate some salient points from the Denver Workshop in the context of events which stimulated the organization of the workshop and those transpiring subsequent to it, rather than simply repeating the proceedings as now available in written form (JACA, 1985).

An important theme to the workshop was the recognition that problems exist, that they are real problems which cannot be ignored, and that they are problems which must be solved. The scope of materials included in the term "pesticide wastes" runs a broad gamut: Empty containers, unwanted/outdated products, tank and equipment rinsewaters, left-over materials, equipment washwaters, incompatible mixtures, spilled materials, stormwater and runoff from natural occurrences, and debris from fires (Ehart, 1985; Keane, 1985). While the immediate driving force for solving the waste problem is the existence of increasingly stringent federal and state regulations, the contribution of such wastes to visual, air, soil, and water pollution can not be overlooked. Improper waste disposal can lead to contamination of surface and ground water, accentuating the problem of contamination which can occur as a result of registered uses of crop protection chemicals.

On a brighter note, improper pesticide waste disposal affords a manageable problem which with sufficient effort can be solved nearly to the point to eliminating it as an environmental hazard. Proper waste disposal should be regarded as an integral part of "product stewardship" so often touted as a means of combating the negative feeling toward pesticides which exists among many of our citizens.

The challenge of proper disposal is not a new one. Several symposia, books (Kennedy, 1978; Krueger and Seiber, 1984) and reports (Day, 1976; Hall et al., 1981; Munnecke et al.,1976; SCS Engineers, 1979; Wilkinson et al., 1978) have dealt with this subject just in the past ten years. The Resource Conservation Recovery Act (PL 94-580, 1976) made the situation more immediate by requiring persons generating acutely hazardous waste (including many pesticides) to notify EPA by August 14, 1980, and comply with interim status facility standards by November 12, 1980. Many commercial pesticide applicators, who could be above the minimum level of waste generation, notified EPA by the deadline. While some guidance of a general nature was provided by EPA in 1981 (Fed. Reg., 1981) to owners and operators of treatment, storage, and disposal systems (which could include commercial applicators who handled wastes at their sites of operation), specific details on how to comply with RCRA were not available at the time of notification or, to a certain extent, even now. That is, pesticide applicators were caught, as were other Small Quantity Generators (SQG's), in RCRA requirements, told that their past disposal practices were illegal, but not given specific steps they could take to come into compliance. This is not to imply that disposal options which could satisfy RCRA did not exist; the problem lay more with sorting out the options, proving their technical and economic feasibility, obtaining official sanction, and making them known and available to users (Seiber, 1981).

This background provided the stimulus to several organizations including EPA, USDA, and the National Agricultural Chemicals Association (NACA), to consider the National Workshop approach. In Spring, 1984, the Waste Management Subcommittee of NACA's Environmental Management Committee spearheaded the organization of this first National Workshop.

NATURE OF PESTICIDE WASTES

In general, any excess pesticide concentrate, unapplied diluted material, and discarded container remaining after applications of pesticide are completed may be regulated as wastes (Ehart, 1985). Beyond this general description lie several intricacies. Containers if triple rinsed or equivalent are not regulated as hazardous waste. Unused material remaining in the container or spray tank, and rinsewater used to remove it and to clean the spray booms and equipment exterior are not regulated if they are applied subsequently to the crop for which the pesticide is registered. This has given rise to the practice of using rinsewaters as diluents whenever possible -- a practice which can go far toward minimizing the quantities of wastes to be dealt with. In some cases, the step of applying the rinsewaters themselves to the crop, usually along field borders, can be economically justified (even though it entails an extra excursion by the applicator) because of the mounting cost of handling the rinsewaters as wastes. This operation might be done when changing from one chemical to another to prevent cross contamination (Keane, 1985).

Somewhat surprisingly, the nature of rinsewater contents was not dealt with directly at the Denver Workshop, and in fact has only been addressed in any detail in just one prior report (Whittaker et al., 1979). Considering that a typical tank mix concentration is on the order of 10,000 ppm of active ingredient, that 1-8 gallons remain as residue in the tank, and that 10-80 gallons of water are used to flush the residue, it follows that typical washwater will contain approximately 100-1,000 ppm or 0.07-0.7 kg of pesticide. Additionally, the tank washwater will also contain additives (solvents, emulsifiers, other adjuvants) and any other agents (fertilizers) applied simultaneously with the pesticide. In the one prior report, actual analyses of spray plane tank and boom rinsate revealed up to 18,000 ppm of total solids. Washings from the exterior of the aircraft were much more dilute -- less than 1/10th that of the tank rinse -- but presumably more heterogenous because of the presence of dirt, oil, hydraulic fluid, insect parts, and other debris (Keane, 1985). Subsequent to the Denver Workshop, aircraft exterior washwater was judged not to fall under the "mixture rule" and thus do not constitute a regulated waste regardless of the chemical(s) used. Certainly, a more concerted effort to characterize, by direct analysis, the variation in concentrations of chemicals in typical spray equipment washwaters would be useful in devising wastewater treatment strategies, and perhaps delisting or exempting specific types of waste.

In addition to the origin of the washwater, the chemical nature of the contents is important to determining what wastes are regulated. In sum, only those pesticides and formulation ingredients appearing on the RCRA E and F lists (Ehart, 1985; Krueger, 1985) are regulated, and only when the summed amounts exceed the exemption level for Small Quantity Generators. For many such chemicals, the exemption level will be lowered to 100 kg/mo in 1986 -- an amount which could be exceeded in a single washing operation.

One point worth noting in relation to the RCRA E and F lists is the presence of several pesticide breakdown products on them. These include:

Parathion E List	→	p-Nitrophenol F List
Propargite	→	Propargyl Alcohol E List
Monuron	→	p-Chloroaniline E List

Thus, a disposal strategy which relies on hydrolysis of parathion to p-nitrophenol would be of limited benefit because it merely alters the chemical composition, from one (parathion) falling on the E List to one (p-nitrophenol) on the less restrictive F List. Simple hydrolysis of propargite and monuron would definitely be disadvantageous because it would create products on the E List from parent pesticides falling on neither the E nor F Lists.

A major problem in devising treatment strategies for pesticide wastes is the diversity in types and properties of the chemicals registered for use (Kearney et al., 1985). There are *ca.* 680 pesticide active ingredients, of which some 30 account for 90% of agricultural applications. These 30 include chemicals with water solubilities ranging from less than 1 ppm (trifluralin, toxaphene) to totally miscible (2,4-D salts), vapor pressures from $<10^{-6}$ Torr (2,4-D salts) to >1 Torr (Telone), and soil persistence times of <1 (butylate) to >30 weeks (toxaphene, terbuphos). The soil persistence can be dramatically affected by the formulation type and concentration level, and several environmental factors.

It is thus quite unlikely that any single disposal strategy will be equally applicable to all pesticide types and environmental conditions. This is particularly true for biological degradation, where a fairly narrow range of conditions must be satisfied for optimal breakdown (Craigmill and Winterlin, 1985).

A special waste disposal situation exists at outdated/abandoned sites which did not have the design features mandated by current standards. These include evaporation ponds without double liners (or, in many cases, any liner at all), no groundwater monitoring capabilities, and location near to well sources and/or human activity. These sites -- some on public lands -- may be classed as hazardous waste sites under federal or state superfund regulations. They may thus be subject to civil and criminal penalties, and to a fairly immediate remedial cleanup action requirement (Craigmill and Winterlin, 1985; Masterman, 1985). In these cases contaminants are present in the soil, with the potential of having been mixed or leached to several feet below the surface. Concentrations at one such site we recently studied, to be detailed in a later presentation by Dr. Craigmill at this Workshop, were in excess of 800 ppm for 4 chemicals in the top 4 inches of the dried evaporation pond sediment, with concentrations exceeding 100 ppm for two of these at a depth of 2 feet. The options for cleanup of such sites are quite limited, including removal to an approved waste disposal facility (usually at great cost) or on-site decontamination by chemical/microbial means (Craigmill and Winterlin, 1985). In retrospect it is clear that the cleanup costs and potential civil and criminal penalties are so great that the long term cost of improper management will far exceed any short term savings (Masterman, 1985). The question facing those involved in such situations is who should pay, given that several applicators may have been involved, often with some concurrence of local agencies, and even in compliance with the general disposal statements on the pesticide label.

With regard to the latter point, it is clear that the pesticide label must be made more explicit in terms of what disposal options are legal for a given product. General label guidance statements have been updated recently (Krueger, 1985), but do not yet give the type of specific information one needs to carry out disposal of unused product or in equipment washwater.

TREATMENT OPTIONS

In approaching the subject of treatment and disposal options, several means of classification exist. The one employed at the 1985 Denver Workshop delineated physical, biological, and chemical treatment options, with the topics of land disposal of rinsate, incineration, and containers handled separately. Another classification might be based on whether the option is relatively simple and inexpensive, and thus can be practiced on site, or employs more sophisticated, esoteric techniques which require transportation of the waste off site to some central disposal location. The two classes are not mutually exclusive, because one step in a given option (e.g. carbon adsorption) may be done on-site, with a subsequent step (incineration of carbon) done off-site. If the on-site off-site classification were imposed on the techniques discussed at the Denver Workshop, it might appear as follows:

On-site	Off-site
Carbon adsorption	Incineration
Evaporation	Activated sludge
Land disposal	
Biological treatment	Molten salt
Chemical treatment	Others

The on vs off-site question is important because of the regulatory requirements of storing, handling, and shipping pesticide wastes for off-site treatment (Hill, 1985). On the other hand, if one wishes to treat on-site, this will entail permitting, monitoring, and reporting requirements tailored to the treatment facility proposed. Many participants at the Workshop felt that on-site treatment might be the more practical alternative for wash and rinsewaters, while off-site treatment with an organized collection system might be more suited to container disposal. However, basic economic, regulatory, safety, and expediency decisions are yet to be made, and in fact the decisions may vary from one region of the nation to another.

A general schematic for on-site treatment includes as components a wash pad for cleaning equipment, a sump/pump system for transferring rinsates to a storage tank, and a containment for evaporation of excess water (Figure 1). Variables include the separation of suspended and dissolved materials (e.g. flocculation/sedimentation stage), removal of the bulk of the dissolved organics (e.g. adsorption stage), introducing chemical reagents (e.g., in the storage tank or evaporation area), and the design of the containment/

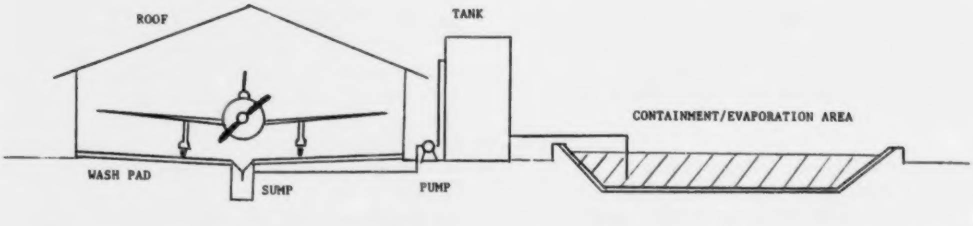

Figure 1. Essentials for an on-site disposal system for pesticide wastewaters.

evaporation area. Depending on choices in these categories, the waste effluent may be cleaned to the point of reuse of the water as spray mix diluent or for more than one washing operation, with only occasional effluent reaching the containment area for "finishing".

TABLE 1 ADSORPTION SYSTEMS FOR ON-SITE DISPOSAL OF PESTICIDE WASTEWATERS

Developer	Stages 1	 2	 3
Purdue	Flocculation/Sedimentation	Carbon Adsorption	Sludge/Carbon Disposal (Encapsulation)
U.S. Army	Filtration	Carbon Adsorption	Carbon Disposal (Landfill)
VPI	Peat Adsorption	Peat Disposal (Composting)	

A. Adsorption/Evaporation

Three adsorption systems were presented at the Denver Workshop (Nye, 1985; Dennis, 1985; Craigmill and Winterlin, 1985) with more detail added at the Cincinnati Research Workshop (Bridges and Dempsey, 1986). A summary is in Table 1.

The Purdue system has been well studied for use with agricultural applicator wastewaters, including installation at several commercial pesticide applicators. Its broader use would be facilitated if a commercial firm were to design and develop the physical equipment, and market the system. In fact, at least one firm has proceeded to do so, and installed 2 demonstration systems recently in California (Antommaria in Bridges and Dempsey, 1986). Total capital cost is $20,000 per unit and the water is expected to be recyclable after the 3-stage carbon processing. The spent carbon and sludge can be encapsulated in concrete and then landfilled, or hauled off-site for incineration.

The U.S. Army system has been operated on a smaller scale and with more limited testing of types of pesticides accommodated (Dennis, Jr., 1985). In its present form it appears more suited to the needs of pest control operators working with smaller application equipment and fewer types of chemicals. It can, in fact, be portable and thus brought to PCO sites for periodic cleaning of stored wastewaters -- the use envisioned by its developers. An interesting aspect to the Army study was the development of a simple TLC assay which can be used at the site to monitor chemical concentrations in the treatment effluent.

The VPI system uses adsorption on an organic matrix, such as peat moss, followed by microbial degradation of the enriched peat moss by a compost process (Mullins in Bridges and Dempsey, 1986). This appears to be quite simple and promising, although to date only one chemical (diazinon) has been tested.

Evaporation systems presently in use or proposed for use include ponds and soil-filled beds. The former are simply lined lagoons in which water and some chemical volatilizes, and the residual water becomes progressively more enriched in less volatile chemicals. At their best, evaporation ponds are an excellent means of volume reduction for heterogenous aqueous wastes. On the negative side, there is a large potential for escape of airborne materials (often quite odiferous), there is always a secondary residue to be dealt with eventually in the concentrated water, and the lagoons must be double lined and monitored frequently to avoid leaking to underlying soil and water. The negatives seem to outweigh the positives in this strategy unless chemical reagents can be developed to degrade toxicants to innocuous materials in the lagoon itself.

The soil evaporation systems, as extensively tested at Iowa State University and the University of California field stations (Craigmill and Winterlin, 1985; Hall et al., 1981), offer some advantages. While preserving water evaporation and thus volume reduction, the soil adsorbs toxicants thereby minimizing the potential for their loss by volatilization or system leakage while creating an environment in which slow microbial and chemical degradation can occur in a manner analogous to what normally happens in treated fields. The UC system provides for subsurface feeding of the wastewater, so that net water movement is upwards in the containment when environmental conditions favor evaporation. Both systems are amenable to further manipulation in terms of prior adsorption or chemical treatment of the wastewater to be contained and evaporated, and addition of nutrients to the soil to maximize biodegradation. On the negative side, neither system has been thoroughly tested for the presence of toxic degradation products, and both have the same liner and monitoring requirements mentioned above for evaporation lagoons. If the containments were constructed on the soil surface rather than imbedded in it, monitoring could be relatively simple including by visual inspection (Winterlin in Bridges and Dempsey, 1986).

An extension of this concept is found in the Chemical Control Centers in use on many small fruit farms in the northeast U.S. (Spittler in Bridges and Dempsey, 1986). These centers use leach lines embedded in the soil to distribute wastes back to the field for subsequent weathering. While no adverse effects were noted in follow-up monitoring, the potential for contamination of surface and subsurface water in the leach fields is a drawback of this approach.

B. Biological

Biological treatment, specifically the use of adapted microorganisms in activated sludge and trickling filter systems, has much utility for degrading toxic chemicals (Craigmill and Winterlin, 1985). To generalize, most such systems are best adapted to handling one or a few chemical wastes fed at a relatively constant rate in a reasonably well-managed environment, and thus seem more suited for industrial effluents than for agricultural wastewaters. Exceptions to this generalization lie in the relatively slow but more flexible mixed microbial populations encountered naturally in soil, sediments, and compost piles. The use of these natural cultures may best lie in containments receiving wastewater or pre-treated wastewater, such as in the evaporation beds and compost piles mentioned above, and in detoxifying contaminated soil at disposal sites no longer in use. Once again, the formation of toxic intermediates in the degradation process can not be discounted, and proper containment of wastes for a relatively long period of time is required because these natural processes, even when artificially facilitated by addition of nutrients, can be quite slow particularly when co-metabolism is required for degradation. Some help in speeding things up may eventually come with the use of isolated enzymes capable of catalyzing specific transformations, and in genetically engineered "super-bugs" which can withstand harsh environmental conditions, variable chemical concentrations, and gross mixtures (Matsumura in Bridges and Dempsey, 1986).

C. Chemical

Honeycutt (1985) described options currently available for chemical degradation of wastes -- a theme further amplified by several speakers at the Cincinnati Workshop (Bridges and Dempsey, 1986). They include fairly exotic, technology-intensive systems capable of completely mineralizing organic wastes rather rapidly (microwave plasma, molten salt methods), systems capable of effecting partial degradation through one or a few specific chemical degradation steps (oxidation, photolysis, hydrolysis, reduction), and systems employing combinations of approaches (UV/ozonation, sunlight/oxidation, hydrolysis/oxidation). Several of these offer fairly immediate use in handling agricultural wastewater.

The system most thoroughly studied at the field-ready scale is the UV/ozonation procedure developed at the USDA, Beltsville, research center. Wastewater containing agricultural pesticides such as atrazine and 2,4-D and animal parasite control agents such as coumaphos are degraded in the ozonation unit to more polar, less toxic, and more biodegradable products. Normally, this technology is to be used in combination with microbial metabolism either as a pre- or post-treatment. The system is commercially available, potentially portable, and has a relatively low operating cost; however, it will require more study with a wider variety of chemicals before being recommended for general use.

Solar photodecomposition, using photoactive metallic oxide catalysts, is a promising technique for degrading a variety of chemicals (including those resistant to other degradation processes). The energy and technology requirements are quite simple, involving only adding the catalyst to water exposed to sunlight, and complete mineralization can occur. This could be a useful add-on to existing holding/evaporation pond technology (Nozik and Cooper in Bridges and Dempsey, 1986). The use of other hydrolytic and/or oxidizing agents, such as hypochlorite, perborate, and peroxide bleaches, effects partial to complete degradation of many pesticides and thus shares many of the same advantages. One cautionary note in pursuing this technology is in the potential for forming toxic intermediates, while a second lies in the potential deactivation of the reagents by solvents and dirt before they attack the pesticide of interest. At any rate, the goal of finding chemical reagents which can "neutralize" a given waste (and perhaps be purchased along with the pesticide) by simple addition and mixing when needed is so attractive that it should be pursued vigorously.

D. Combinations

The concept of combining physical, biological, and chemical principles of removal/degradation of wastes into single systems affords a viable approach to handling wastewaters containing a variety of chemical agents. This has been mentioned in connection with several of the processes described above, and can be more formally summarized as in Figure 2.

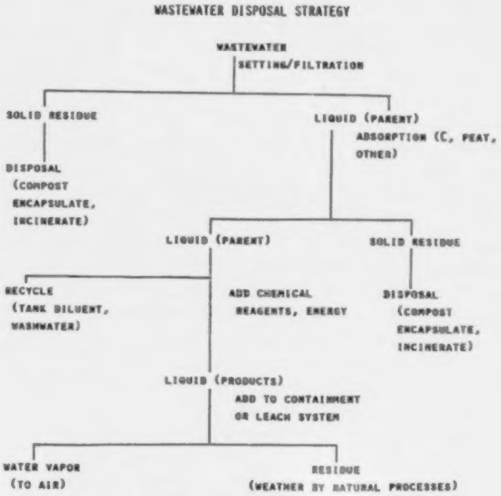
WASTEWATER DISPOSAL STRATEGY
WASTEWATER
SETTING/FILTRATION
SOLID RESIDUE
LIQUID (PARENT)
ABSORPTION (C, PEAT, OTHER)
DISPOSAL (COMPOST ENCAPSULATE, INCINERATE)
LIQUID (PARENT)
SOLID RESIDUE
RECYCLE (TANK DILUENT, WASHWATER)
ADD CHEMICAL REAGENTS, ENERGY
DISPOSAL (COMPOST ENCAPSULATE, INCINERATE)
LIQUID (PRODUCTS)
ADD TO CONTAINMENT OR LEACH SYSTEM
WATER VAPOR (TO AIR)
RESIDUE (WEATHER BY NATURAL PROCESSES)

Figure 2. A systems approach to wastewater disposal.

Some steps could be bypassed, combined, or altered to fit the needs of individual users. Perhaps we should look more at developing such a "systems approach" to handling liquid wastes, rather than several independent processes. To a certain extent this concept is already being applied to container disposal (Figure 3).

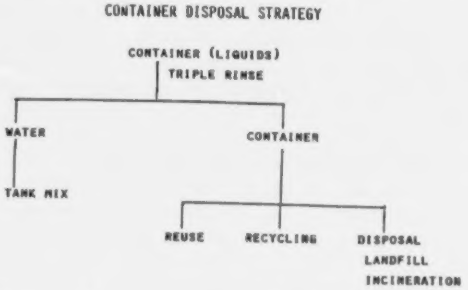

Figure 3. A systems approach to container disposal.

One of the major advantages of the Workshop approach is that it provides an opportunity to look at the whole field of possibilities, see where technologies can be linked, and thus work more effectively toward integrated solutions to the disposal problem.

SUMMARY

The Denver Workshop provided a forum for exchanging ideas across a broad front, ranging from the needs of applicators, through the rationale for and intricacies in existing and planned regulation, and including some practical here-and-now approaches as well as meritorious concepts for future development. The most pleasant surprise was the size and diversity of backgrounds of the attendees -- a point which clearly underscored the urgency of solving the waste disposal issue. Among several very appealing ideas which surfaced during the Workshop were the concept of delisting some wastewaters from the regulated waste classification and of minimizing wastewaters by spraying them on the target or recycling them as diluent to subsequent tank mixes, and of eliminating some entirely by use of in-boom mixing and system purging over the target. Such measures might well reduce the volume of wastewater generated in the future to a fraction of that of the past. The most tantalizing idea was to develop a chemical reagent which could be added to wastewater to "neutralize" (i.e. detoxify) residual material -- clearly an idea worth vigorous pursuit in the future. The availability now of relatively simple reagents which could help in degrading chemicals in storage tanks and evaporation containments is a step in this direction, as is the artificial facilitiation of microorganisms capable of accelerating the degradation of wastes in containments and abandoned disposal sites.

The biggest unknown for many attendees was at what level of waste chemical removal could the contaminated water or soil be considered safe, ie "how safe is safe". Apparently, individual states are drawing up target figures, but the pesticide industry as a whole has little input into the process. The biggest disappointment for the users attending the conference was the lack of vendors of approved systems. Some users are clearly eager to purchase disposal systems if and when they became available. A point of confusion in the Workshop centered on the legal acceptability of land disposal, or land-farming, as a disposal option. The most ignored issue in the Workshop was the possibility of producing hazardous secondary residues in the act of removing the primary (parent) chemical. Few analytical data were presented giving complete characterization of the "decontaminated" wastewaters. The most worrisome point may well have been the economic plight of aerial applicators, for whom the cost of adhering to new waste handling regulations might be prohibitive given other economic pressures on this industry.

The most tangible result of the Workshop was that it led directly to a Research Workshop only 6 months after Denver, at which many decisions were reached on what technologies should be further pursued and a mechanism for funding 5 areas was implemented. Less tangible but still quite positive results could be found in the stimulation and sense of urgency imparted to the attendees, and the raising of expectations that, indeed, progress was being made and that solutions were on the horizon.

ACKNOWLEDGEMENT

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INDUSTRY'S ROLE IN USERS' WASTE DISPOSAL

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ABSTRACT

The agricultural chemicals industry recognizes its role to assist pesticide users to find waste disposal options which are environmentally sound, cost effective and realistic in meeting their legal responsibilities. The National Agricultural Chemicals Association (NACA) has funded five verification studies to further enhance technology that can lead to practical and accessible treatment/disposal of pesticide wastes. Equally important is the identification of a regulatory scheme which recognizes the types of wastes associated with pesticide use and is responsive to the economic and operating restrictions facing both private and commercial applicators.

This paper will present NACA's assessment as to its role and responsibilities in the identification and implementation of pesticide users' waste disposal strategies.

For the past four years, NACA has been considering environmental needs of those who use our industry's products. Our focus has been primarily on waste disposal and water quality issues. The waste disposal program we decided upon took the form of providing information to applicators on the relevant regulations and, in general, effective waste management practices. It became apparent early on to our Waste Management Committee that the regulations governing the wastes generated from pesticide use were defective. They did not relate to the economic and operating conditions of pesticide applicators. Nor were the regulations really responsive to the types of wastes involved. They were the same regulations companies must comply with in dealing with more concentrated chemical wastes. In providing guidance to pesticide applicators, the regulations left something to be desired.

Consequently, NACA's objective of developing informational assistance to pesticide users had to be put on the "back burner," until the regulations and technology were better defined. We recognized a serious need for regulatory programs that would allow practical and environmentally sound waste management practices for pesticide rinsewaters, empty containers and pesticide-containing soils resulting from spills.

These circumstances led us to seek formation of this National Workshop on Pesticide Wastes Disposal. At that time, probably the only ones who knew that pesticide applicators had serious and almost impossible challenges to effectively and economically comply with federal and state regulations were the applicators themselves. Needless to say, Harold Collins, of the National Agricultural Aviation Association, was delighted about the prospects of a workshop similar to what Jim Seiber, our previous speaker, had been recommending for several years. When contacted, the organizations listed as Workshop co-sponsors enthusiastically agreed that such a forum was needed. Thus the National Workshop on Pesticide Wastes Disposal came into existence. I would like to acknowledge at this time the personal commitment and support that Francis Mayo of the Environmental Protection Agency (EPA) provided in helping to launch the Workshop. And I'd be remiss if I didn't recognize the many hours our own Tom Gilding has spent on this project.

This Workshop forum enables representatives from academia, federal and state government, the agricultural chemicals industry, and pesticide user groups to work together to formulate technical and regulatory solutions to the various aspects of the pesticide users waste disposal problems. The Workshop is now a physical reality and more importantly is the evidence of commitment among the groups involved. It is an opportunity to make things happen.

Last year's Workshop was a good start, in the sense of "baselining" the issues involved. As in any good management approach, the first requirement is to define the problem before attempting to devise solutions. If anything, the first Workshop made the non-applicator groups; i.e., NACA, EPA, etc., more aware and appreciative of the situation that pesticide users already knew all too well.

Much has happened since last year. You will hear about it during this year's Workshop. However, much more needs to be done; we cannot let up. NACA is committed to the achievement of the objectives on which this Workshop is based and, as such, has clearly defined its role as a partner with the other cosponsoring organizations towards making this a reality.

One role I see for the agricultural chemicals industry is to work with EPA, U.S. Department of Agriculture (USDA), and pesticide applicators towards defining those technologies that pesticide applicators can use in managing the wastes generated from pesticide use. During the past year NACA member companies funded the five technology demonstration projects which will be discussed in the next presentation. Additionally, some companies are individually supporting similar efforts specifically related to their products. These "screening" projects are necessary to begin more specific feasibility studies on those technologies. I'm talking about those technologies selected as viable candidates for treating/disposing of the types of wastes we are looking at. We hope that the funds our industry has provided for these projects will lead to the selection of promising technologies for further research and demonstration.

I look forward to the joint presentations by Phil Kearney and Francis Mayo on their assessments and insights into future research needs. NACA believes that further research is needed across the board. But care must be taken to insure that we identify as accurately as possible what research or demonstration is really necessary in fulfilling our technology objectives. Since all of our organizations are "resource limited," it is essential that we adhere to guiding principles for these research initiatives that will assure efficient use of resources expended by academia, government, the agricultural chemicals industry, and pesticide applicators. These guiding principles should strive for technology that achieves compatibility with the applicators' operating conditions, effectiveness in protecting the environment, and regulatory acceptability. Further, NACA believes that EPA should provide guidance on what will be acceptable from the regulatory standpoint. In addition, the agency should also begin conducting its own qualification studies for that purpose.

The success of the Workshop objectives is greatly dependent upon the regulatory programs at the federal, state and local levels of government. It is fair to say that the existing regulations are neither realistic nor responsive to the types of pesticide wastes generated by applicators. Moreover, as was pointed out last year, there is confusion due to the administration of the regulations themselves. NACA agrees with the view that federal and state Resource Conservation Recovery Act (RCRA) regulations currently in effect were really not designed with pesticide rinsewaters or empty containers in mind. Understandably, the RCRA program primarily addressed the manufacturing segment of the industry and the much greater concentrated process wastes. The extensive permitting process and treatment technologies required by RCRA are certainly beyond the economical reach of the pesticide applicator community and exceed what is actually needed.

Federal and state pesticide waste regulations must be modified if applicators are to fulfill their legal responsibilities and protect the environment as well. When I talk of modifying existing regulations, I do not mean arbitrary loosening of regulations. On the contrary, NACA--and this is consistent with what I understand the applicator community to be saying--believes regulations are essential. However, such regulations must be defined to: (1) protect the environment, and (2) allow compliance by the regulated community. As part of our commitment to the Workshop, we at NACA are ready to work with the applicator community, EPA and anyone else for the purpose of identifying regulations which meet the above criteria. We see our role, in the regulatory process and working directly with the applicators themselves, as one of helping to develop effective and safe management practices for pesticide wastes. I believe it is appropriate here for me to suggest that consideration be given to an approach for defining these regulations: EPA (Office of Pesticide Programs (OPP) and Office of Solid Wastes (OSW)) should call together those interested parties to work out a responsible and effective regulatory program for pesticide wastes. EPA has already done something along that line in its negotiated rulemaking under Section 18 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). It is presently doing the same concerning Farm Worker Safety regulations. I understand Marcia Williams, according to an article in CHEMICAL WEEK, is interested in the negotiated rulemaking process for RCRA. Such action, under the joint responsibility of OPP/OSW, might just prove to be the way to resolve the regulatory dilemma facing the applicator community.

There are some very complex issues which will have to be addressed in such rulemaking decisions. The major ones that NACA sees, at the moment, are (1) the respective roles of and relationship between RCRA and FIFRA; (2) the regulatory program, including its administration; and (3) the communication of resulting regulations to pesticide applicators.

As to whether the regulations should be under RCRA or FIFRA, NACA believes the management of wastes generated from pesticide use should come under the purview of FIFRA. FIFRA is the statute which regulates the sale and use of pesticides. NACA considers the safe disposal of wastes to be the final step in the safe use of pesticides.

To assure sound management under FIFRA, we recognize and agree that the resulting regulations must adequately meet the intent of RCRA. This means that FIFRA regulations would have to assure the same or greater degree of protection of the environment as intended under RCRA. FIFRA regulations could afford the opportunity to design the regulatory strategies relating to pesticide wastes and the applicators' operating conditions.

Finally, the last role I see for our industry is, in fact, what we had in mind initially. It is to provide information to pesticide users on sound waste management strategies. Once we get answers to the regulatory and technology challenges associated with pesticide waste disposal, tangible gains then will be possible through informational assistance programs.

I personally believe that the greatest gains and benefit in any undertaking can be derived through educating the human factor.

With information properly organized and focused comes comprehension. With comprehension, we then can apply the resources available to us to solve the problems. That's what we're doing here.

CARBON ADSORPTION TREATMENT OF RINSEWATER

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ABSTRACT

A carbon adsorption treatment unit was constructed and tested during the fall and winter of 1985-86. The objectives of the test were to identify the critical factors that affect the flocculation of pesticide contaminated waste-water and to provide the data for use by applicators and regulatory agencies to adopt this technology.

The treatment system consisted of one-250 gallon flocculation tank, four-6 in. ID by 4 foot long PVC columns filled with filtrasorb 300 and 400 activated carbon(Calgon, Inc), an air driven variable speed mixer, a Masterflex variable speed pump, a portable air compressor and portable generator. The total cost of the complete unit with supporting chemicals and lab equipment was $3500.

A series of flocculant aids were tested. Included in these tests were Ultrion 7109, a cationic coagulant that contains aluminum chloride; Nalco 7132, a polyquaternary amine choride; Nalclear 7763, an anionic flocculant, Nalcolyte 8108, a polymine coagulant and Nalco PF100, a ferric sulfate flocculant. These flocculant aids were supplied by the Nalco Chemical Company. Ferric sulfate and aluminum sulfate were also used in jar test. The sludge characteristics were evaluated and the turbidity of the supernatant was observed. The supernatant was analyzed for pesticide content.

The paper describes the operation of the treatment unit and projects the cost of using this method to treat pesticide contaminated waste-water. The criteria for selection of flocculant aids are described in detail. The treatment process was effective in removing pesticides from waste-waters.

INTRODUCTION

One of the problems facing pesticide applicators that have used the treatment technique discussed last year by the author (Nye, 1985) has been the selection of flocculants for the pretreatment step. Development of a simplified procedure for screening flocculants was proposed to the National Agricultural Chemical Association and funded in November, 1985. The primary objective was to establish a technique that could be used by pesticide applicators to select the appropriate flocculant and determine the proper dosage for flocculation of pesticide laden waste-waters.

BACKGROUND

Several previous papers have been presented by the author and former graduate students describing the development of the treatment process. Detailed descriptions of each project are presented in their theses (Whittaker, 1980, Ruggieri, 1981 and Farrell, 1984). The essential steps in the treatment process is flocculation and sedimentation of the waste-water followed by adsorption of the pesticide to activated carbon. This system has been used on a wide range of pesticide contaminated wastes with good results.

Pesticide applicators in several states have installed this treatment system. The primary problem that most users have experienced is the inability to flocculate the waste-water. To understand the flocculation step, it is essential to review the basic chemistry associated with flocculation(Sawyer and McCarty, 1978). Although there are numerous new products that are designed to enhance flocculation and sedimentation, the oldest and most reliable products are Ferric and Aluminum salts. When these compounds are added to water with sufficient alkalinity, ferric hydroxide or aluminum hydroxide are formed. These hydroxides form large flocs and settle rapidly. As they settle they remove much of the turbidity in the water. The chemical reactions that produces the aluminum or ferric hydroxide precipitate are:

$$Fe_2(SO_4)_3 + 6\ NaOH \text{ ——— } 2\ Fe(OH)_3 + 3\ Na_2(SO_4)$$

$$Al_2(SO_4)_3 + 6\ NaOH \text{ ——— } 2\ Al(OH)_3 + 3\ Na_2(SO_4)$$

The metal hydroxides settle out of the waste-water and carry with them much of the suspended material in the waste-water. The concentration of ferric or aluminum salts varies depending on the turbidity of the waste-water. In the typical samples of pesticide contaminated waste-waters 300-600 mg/L of flocculant is needed.

To enhance the settling process polymers are added to the waste-water. These polymers can be either anionic or cationic, meaning they either attract positively or negatively charged particles. In most cases the hydroxide molecules will settle more rapidly with anionic polymers. Very small amounts of polymer are required to enhance flocculation. Dosages of 1 mg/L are common.

To convert these dosages to useable figures for applicators the following conversion factors are useful.

1 mg/L = 8.3 pounds/million gallons

500 mg/L = .4 pounds/100 gallons

PROCEDURE

Most pesticides are mixed with organic solvents, emulsions or other compounds that allow them to be mixed with water and form stable solutions. These same compounds create the most serious problem during the flocculation step. To develop a simplified procedure for selecting flocculant aids a synthetic waste-water was prepared, that contained large amounts of solvent and emulsifiers. The makeup of the waste-water is shown in Table 1.

Table 1. Chemicals added to 45 Gallons of water to form synthetic waste-water.

Pesticide Name and Labeled Ingredients		Volume
Super Dairy & Stock Spray		750 ml
2,2-Dichlorovinyl dimethyl phosphate	0.93%	
related compounds	0.07%	
Dimethyl phosphate of alpha-methylbenzyl 3-hydroxy-cis-crotonate	0.25%	
Petroleum distillates	49.75%	
Mineral seal oil	49.00%	
Dursban 30 sec		750 ml
Chlorpyrifos, 0,0,-diethyl 0-(3,5,6-trichloro-2-pyridyl) phosphorothioate	30.0%	
Xylene range aromatic solvent	19.7%	
Inert ingredients	50.3%	
Dermaton 3		750 ml
2-chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate	12.25%	
Inert ingredients	87.75%	
Deltox		750 ml
Dioxathion [2,3-p-dioxanedithiol s,s-bis (0,0-diethyl phosphorodithioate)]	20.40%	
Related compounds	7.10%	
Inert ingredients	72.50%	
Tick Trol		6.6 kg
Permethrin 3-(phenoxyphenyl) methyl (+) cis, trans-3-(2,2-dichloroethenyl)-2-2-dimethylcyclopropane-carboxylate	3.20%	
Inert ingredients	96.80%	

The dosage of flocculant and coagulant were determined through jar test using a series of flocculant aids from Nalco Chemical Company. The jar tests were conducted on 2 L beakers of waste-water. The flocculants and coagulants were diluted to 1 % strengths for simplification in scaling up dosages to the field sample.

The 2 L beakers were filled with about .5 gallons of waste-water. The dosage for 50 gallons would be the same volume of 100 % flocculant. Four beakers were used for each test. The dosages ranged from 200 to 500 mg/L of flocculant for most cases. Initially aluminum sulfate and ferric sulfate were added at the prescribed dose. Then sodium hydroxide was used to adjust the pH. To enhance coagulation and settling, an anionic polymer (Nalclear 7763) was added to the samples. After these initial test, the other flocculant aids were then used at lower dosages as recommended by the Nalco representative. The flocculant aids that were tested are shown in Table 2.

Table 2. Flocculant Aids evaluated in jar test.

Alum	Hydrated Aluminum Sulfate
Ferri Floc	Ferric Sulfate(50% soln)
Nalco #1	Aluminum Sulfate
PF100	Ferric Sulfate
Ultrion 7109	Cationic Coagulant
Nalco 7132	Polyamine
Nalclear 7763	Anionic Flocculant
Nalcolyte 8108	Polyamine

The major thrust of this project was to develop a simplified procedure for selecting type and dosage of flocculant aids for a wide range of waste-waters. While we were successful in flocculating and treating the pesticide contaminated waste-water, we had limited success in simplifying the screening process.

Since many of the pesticides contain solvents and emulsifiers that resist flocculation, the screening of the compounds can be very frustrating. To insure that an applicator can achieve success the following screening process is suggested.

Materials

The following materials are required to screen flocculants:

A. Chemicals

1. Ferric Sulfate or Aluminum Sulfate, 500 grams in 1 L of water.
2. Anionic Flocculant, 0.1 % solution by volume.
3. Sodium Hydroxide, 40 grams in 1 L of water.

B. Equipment

1. Gang Stirrer
2. pH meter or other measurement device
3. Assorted plastic ware including 2 L beakers, graduated cylinders, pipets or syringes.

Method

1. Dilute the initial waste-water with tap water by adding 1 quart of pesticide waste-water to 2 gallons of water.
2. Fill four - 2 L beakers with 0.5 gallons of diluted waste-water and start mixing with gang stirrer.
3. Add flocculant to the waste-water in varying dosages from 1 to 5 mL.(1 mL of 500,000 mg/L flocculant in .5 gallons is approximately 250 mg/L dosage)
4. Adjust pH to 7.0 using sodium hydroxide. (Add about 2 mL of hydroxide for each mL of flocculant)
5. Add 1 mL of the anionic polymer that has been diluted to a 0.1% solution.
6. Mix at high speed for 1 minute, then reduce mixing speed to low (10 rpm) for 5 minutes and then off.
7. Select flocculant with good separation and lowest dosage.
8. Repeat steps 2 through 7 with increasing concentrations of waste-water. Dosage of flocculant may have to be increased.

RESULTS

The waste-water from the formulation plant that was used in the study was difficult to flocculate. Raw waste-water samples were treated with alum and ferric sulfate at dosages up to 1000 mg/L with no success. The waste-water was diluted to 10 % strength and flocculation was successful at dosages of from 300 to 600 mg/L. An experimental protocol was established to determine the rate of sludge accumulation with subsequent resuspension of settled solids. The initial sample was made up of 10 % pesticide and 90 % tap water. These samples were flocculated with alum and ferric sulfate. After settling, the volume of sample was reduce to 1.8 L and 200 mL of raw waste-water was added. This procedure was followed through 5 resuspensions of sludge. After each flocculation the volume of sludge was measured. The first sample that contained 10 % waste-water would flocculate with Nalco #1 (40 % aluminum sulfate) doses of 300, 400, 500, and 600 mg/L. The 400 mg/L dose was the most effective producing the clearest supernatant. The volume of settled sludge ranged from 300 and 400 mL. The supernatant was decanted from the beaker, leaving 1.8 L of total volume. 200 mL of waste-water was added to each beaker. The mixer was started and the sludge was resuspended. The same doses, 300 to 600 mg/L of Nalco 1 were used again with no successful flocculation. The dosage was increased to 700, 800, 900 and 1000 mg/L. At these doses good separation was achieved. The volume of settled sludge was between 400 and 500 mL. The same procedure of decanting supernatant to the 1.8 L volume, adding 200 mL of waste-water and then flocculating with same dosages of Nalco #1 was used. The volume of settled sludge remained between 400 and 550 mL. In all these trials the volume of sludge was recorded after 1 hour of settling.

These jar tests indicated that the waste-water could be flocculated using the resuspended solids with the addition of flocculant. The most effective dosage of Nalco #1 was 800 to 1000 mg/L (an aluminum sulfate dosage of between 300 and 400 mg/L alum).

Ferric sulfate was then evaluated in the same manner. Ferri-Floc, a 50% ferric sulfate solution, was used for these jar tests. The first 10 % solution of waste-water could be flocculated with ferric sulfate dosages of 300, 350, 400 and 450 mg/L. The volume of settled sludge was less than 200 mL. The supernatant was decanted to the 1.8L volume and 200 mL of waste-water was added. The sludge was resuspended with the mixer and flocculant was added at the same dosages. This procedure was continued four times. Good flocculation was achieved with the 350, 400 and 450 mg/L dosages. The 300 mg/L dose failed to flocculate the waste-water on the third trial. The volume of sludge remained at 200 mL. Because the ferric sulfate produced a much more dense floc that settled more rapidly, it was selected for treating the larger volumes of waste-water.

The same procedure was followed for 55 gallon drum quantities of the waste-water. About ten gallons of waste-water was added to 40 gallons of water. Based on the jar tests in a 300 mg/L dose of ferric sulfate was used initially. After 150 mL of ferric sulfate was added, 150 mL of 10N sodium hydroxide was added to produce the ferric hydroxide which flocculates and settles. These samples were observed to determine if additional flocculant was needed to settle the waste-water. For the first batch flocculated in the 55 gallon drum, a total of 200 mL of ferric sulfate was added. The air drive mixer was used to agitate the drum while the chemicals were added. The mixing speed was reduced while the flocculant aid was added. After 1 minute of gentle agitation the mixer was shut off. The flocculant was allowed to settle overnight. The next morning the supernatant was pumped through the activated carbon columns. This treatment schedule was used for the remainder of the test.

Table 3 presents the sequential batch treatment of the waste-water. The sludge was resuspended during each treatment. The amount of waste-water that was added to the sludge varied and flocculant dosage was determined visually.

Table 3. Chemical dosages required for batch flocculation of pesticide contaminated waste-water

Wastewater added L	Chemical Dosage Flocculant[1] mL	Hydroxide[2] mL	Polymer[3] mL
44	200	200	100
38	200	175	150
44	450	515	200
32	400	420	75
64	550	540	100
59	550	500	75
59	700	700	100
38	850	850	100
64	850	850	100
70	1350	1250	100
81	2600	2550	200
81	3000	2950	100

[1] Ferri-floc, 50 % solution of ferric sulfate

[2] Sodium hydroxide, 10 N

[3] Nalclear 7763, anionic polymer, 0.1% solution

As the sludge accumulated in the drum we expected to be able to achieve flocculation with lower dosages of chemicals. This was not the case. After 12 resuspensions, the dosage for flocculation had risen to an incredible 3000 mg/L of Ferric Sulfate. The last two treatments had the highest concentration of pesticide contaminated waste-water and required the largest dosage of chemicals. Even with these high dosages, the supernatant remained turbid. The original results from the jar test, indicating that less chemicals are required to treat diluted mixture, held true for the larger scale trials.

Limited data on the concentration of pesticide in the effluent is available at this time. The initial analysis indicates that the concentration of permethrin in the effluent is about 0.2 mg/L. The supernatant after ferric sulfate and alum flocculation all had essentially the same concentration of pesticides.

To obtain additional information on the toxicity of the effluent, bio-assays using mosquito fish were conducted. The fish were taken from a drainage ditch on the LSU campus. Four fish were place in a solution of 0.5 L of ditch water and 0.5 L of the effluent from the carbon columns. The beaker was aerated and after 5 days all fish were alive and appeared healthy.

CONCLUSIONS

The major objective of this study was to develop a simplified procedure for selecting flocculants for use in the two stage treatment process that had been previously developed. Several commercially available "one-step" flocculants were compared to ferric sulfate and aluminum sulfate. Because of the very large dosages required to break the emulsion, it was found that aluminum or ferric salts followed by the addition of hydroxide produced the most consistent results. Dosages as high a 600 mg/L aluminum were required. It was also determined that the ferric hydroxide would form a denser precipitate.

It is doubtful that most pesticide applicators would have the patience to conduct the numerous jar test needed to find the right dosage, without some "hands-on" training.

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TREATMENT OF PESTICIDE-CONTAINING SOIL

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ABSTRACT

Large amounts of pesticides have accumulated in soils adjacent to aerial applicator landing strips. These soils are currently considered to be toxic waste materials and must be decontaminated. Pesticides of concern include methyl and ethyl parathion and toxaphene. Of these toxaphene is the most resistant to degradation. Since toxaphene is toxic to animals, and is also carcinogenic, then methods to detoxify toxaphene contaminated soils must be found. The objective of this current project is to identify a time and cost effective detoxifying treatment. Specific alternatives are ultraviolet (UV) photo decomposition and microbial degradation. The project was initiated in November 1985. Preliminary data indicate that a UV treatment reduced toxaphene in soil by 27.8% after 42 days. When a UV treatment was combined with microbial degradation, the reduction was 4.9%. However, this latter treatment contained lower initial toxaphene concentrations.

INTRODUCTION

Until recently, toxaphene has been one of the most extensively used chlorinated pesticides in the United States. It was predominantly applied in combination with methyl parathion to cotton fields to reduce insect damage. Since the pesticide was usually applied via aerial applicators, then large amounts of toxaphene have accumulated in soils adjacent to the landing airstrips. Toxaphene is toxic to animals and is also a carcinogin. Hence, soil contaminated with toxaphene is considered to be a hazardous toxic waste material and must be detoxified. Sales of toxaphene in Arizona are shown in Table 1 from the years 1966 to 1980 when it was banned.

TABLE 1. SALES OF TOXAPHENE

Year	lbs. sold (in thousands of lbs.)
1966	1028.5
1968	2028.2
1970	1932.6
1972	1468.3
1974	2031.7
1976	518.5
1978	858.3
1980	0.5

Less is known about toxaphene than any other organo chlorine. This is due to the complexity and variability of its components. It is produced by chlorinating comphene via photolysis in the presence of a catalyst. The resulting insecticide is a conglomerate of at least 177 C_{10} polychlorinated derivatives. Each C_{10} derivative contains 7 to 11 chlorine atoms accounting for approximately 68% of the total weight. The empirical formula is $C_{10}H_{10}Cl_8$ with an average molecular weight of 414 (2).

Over the years, toxaphene has been applied to soils in vast quantities. However, concentrations in soil may be reduced by photodecomposition,or chemical and/or microbial degradation. Toxaphene may leave soils via volatilization, or leaching, or be inactivated by adsorption to inorganic or organic colloids. Volatilization has been documented by Williams and Bidleman (3) while Clark and Matsumura (1) have shown that *Pseudomonas putida* can microbially degrade toxaphene.

The overall objectives of this current project was to identify a time and cost effective land treatment of soil contaminated with pesticides.

Specific objectives are to evaluate the following land treatment systems: a) a surface treatment, in which the mode of pesticide degradation was primarily UV photodecomposition; and b) a sub-surface treatment, where the mode of degradation was essentially microbial decomposition plus UV photodecomposition.

In achieving these objectives, emphasis was placed on practical solutions to the problem of decpntamination of pesticide contaminated soils. These solutions must be time and cost effective.

The source of pesticide containing soil in this study was from aerial applicator airstrips in Arizona. Through the years, these soils have acquired large amounts of toxaphene. Large samples of such pesticide laden soils were thoroughly mixed to insure uniform composition. The soil was screened and sieved (<2mm) prior to use.

Wooden boxes were constructed 1 m^2 by 10 cm, lined with plastic, and placed out in the field at the University of Arizona, Marana Agricultural Center. The toxaphene contaminated soil (TCS) was applied evenly in the boxes to a depth of 5 mm. This treatment allowed maximum photodecomposition of the pesticide. Microbial degradation of the pesticide was encouraged by diluting the TCS with 50% Pima clay loam (PCL) which initially contained no toxaphene. The resulting mixture was similarly placed in the boxes, allowing photodecomposition and microbial degradation. Treatments were replicated four times, and left exposed to the atmosphere for a 6-month period. Samples were sacrificed with time and analyzed for toxaphene and methyl and ethyl parathion by gas chromatography.

RESULTS AND DISCUSSION

This project was initiated in November 1985, thus only preliminary data have been obtained. The toxaphene concentration of soils after 0 and 42 days are shown in Table 2.

Thus it can be seen that after 42 days exposure, the toxaphene in the contaminated soil (TCS) was reduced 27.8%, mainly by ultraviolet photodecomposition, whereas when deluted 50% with PCL, the toxaphene was reduced 4.9%. This latter treatment reflects the combined effects of photodecomposition and microbial degradation, but on a soil with a lower initial toxaphene concentration. Note that in both treatments volatilization will most likely have occurred, however the extent of this in unknown.

TABLE 2. TOXAPHENE CONCENTRATION IN SOIL

Time	ppm toxaphene	
days	TCS	50% TCS + 50% PCL
0	19850	9415
42	14340	8958

The initial methyl and ethyl parathion concentration in the contaminated soil are shown in Table 3.

TABLE 3. INITIAL METHYL AND ETHYL PARATHION CONCENTRATIONS IN SOIL

	ppm	
Pesticide	TCS	50% TCS + 50% PCL
Methyl Parathion	0.09	0.06
Ethyl Parathion	0.37	0.24

Since the values were so low, it was decided not to analyze for these contaminants at later sampling periods. It is of interest that the concentrations were so low and reflects the increased rate of degradation of these pesticides in soil as compared to toxaphene.

CONCLUSIONS

Conclusions are really not appropriate, at this early stage of the project. However, it is encouraging that toxaphene concentrations in both treatments were reduced after 42 days in the field.

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BIOLOGICAL TREATMENT OF WASTE DISPOSAL SITES

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ABSTRACT

During the year since the first Pesticide Waste Disposal Workshop the Department of Environmental Toxicology and the Cooperative Extension Toxicology Unit at the University of California, Davis have initiated two field trials to test biological methods for decontamination of pesticide waste disposal sites. One of these trials was the continuation of the cleanup of the Sutter County Airport which started in September of 1980. Results of our first experiments at this site were reported last year. The other field study was initiated last August with the financial support of the National Agricultural Chemicals Association, and is located at the Glenn County Airport in Willows, California. Both of these sites are associated with aerial applicator operations, however the pesticides involved, and the soil types differ considerably.

SUTTER COUNTY AIRPORT
YUBA CITY, CALIFORNIA

The Sutter County Airport at Yuba City, California has a pesticide disposal site that has served as a drainage ditch for the airport for over 10 years. The ditch is approximately 8' deep, 12' wide and 600' long. Pesticide waste water was released into the ditch through one of the runway drains, and flowed through a drain pipe (> 1000 ft long) into the drainage ditch. The major pesticide contaminant is toxaphene and the soil type in the ditch is sandy loam. The ditch has not been used for pesticide disposal since September of 1980, however the drain pipe contains high levels of toxaphene. During the rainy season, additional toxaphene is washed into the ditch thereby recontaminating the soil.

Our initial studies here involved mixing organic matter (cow manure) into the soil followed by flooding with water to promote anaerobic conditions. The results of the first field trial were promising, and this year we initiated another trial to test the effects of other soil amendments on toxaphene degradation. Ten, ten gallon plastic garbage pails were filled with one cubic foot of ditch soil taken within 75 feet of the drain pipe outlet (the most highly contaminated area in the ditch). Dried cow manure, finely ground corn, and blood meal were thoroughly mixed with the contaminated soil as shown in Table 1.

TABLE 1. EXPERIMENTAL DESIGN

Pail #	Cow Manure	Corn	Blood Meal
1	2 lbs	-	-
2	2 lbs	1 lb	-
3	2 lbs	2 lbs	-
4	2 lbs	-	1 lb
5	2 lbs	1 lb	1 lb
6	2 lbs	2 lbs	1 lb
7	2 lbs	-	2 lbs
8	2 lbs	1 lb	2 lbs
9	2 lbs	2 lbs	2 lbs
10	-	-	-

Each pail was placed in the hole from which the soil was removed, flooded with water, and covered. The pails were checked daily to insure that they remained flooded throughout the test period. Soil samples were taken from each pail immediately after flooding, and 7, 13, 29, 48, and 62 days later. Following solvent extraction, samples were analyzed for toxaphene residues using gas-liquid chromatography. Levels of toxaphene were calculated in ppm and capillary GLC was used to define peak shifts associated with biological degradation.

RESULTS:

The quantitative data was anomalous except for the 0 time samples which ranged from 40 to 130 ppm (mean = 83.4 ppm) and was in the range expected based on results of previous analysis. The qualitative data obtained by peak comparisons from the capillary column GLC showed definite shifts associated with biological degradation. Previous unpublished work by Mirsatari and Seiber demonstrated that biological degradation of toxaphene is associated with a shift in the GLC profile to peaks which elute earlier.

The peaks measured are nine distinct toxaphene peaks that are expressed in comparison to the total peak area, 100%. Figure 1 shows the effects of biological degradation on the profile at various times after adding alfalfa meal to toxaphene contaminated soil (Mirsatari and Seiber, 1978). The peaks are numbered in order of elution from the column. Note the relative reduction of the latter peaks 7-9 and the increase in relative height of peaks 1-4 as compared to the standard.

Figure 2 shows the data for all of the test plots on day 0, immediately after flooding the soil. Note that all of the plots show shifts associated with biological degradation as compared to the standard. This is particularly seen as a reduction in the late peaks numbered 6-9, and an increase in the early peaks numbered 1-4. This is most likely due to previous biodegradation that occurred when the entire ditch was amended with manure prior to the 1980-81 rainy season. Figure 3 shows the profiles for the control plot. With the exception of the profile seen at day 29, there is little change seen over the course of 62 days, with only slight increases in the proportion made up by peak 1. Figure 4 shows the profiles for the plot amended with just manure. There are increases in peak 1 towards the end of the test. Figure 5 shows the profiles for the plot amended with just corn meal. There is little change seen over the 62 day test period. Figure 6 shows the profiles for the plot amended with blood meal. There is a substantial change in peak 3 seen at day 7, and increases in peak 1 towards the end of the test. Figure 7 shows the profile change over the 62 day test period for the test plot amended with manure, corn and blood meal. Note the considerable increase in relative size of the early peaks 1-4 as time progressed.

The results of this study confirm our initial observations and those in the literature that toxaphene can be degraded on site using anaerobic biological metabolism. Further laboratory and field studies are planned to further define the parameters that are most conducive to toxaphene degradation in pesticide disposal sites.

GLENN COUNTY AIRPORT
WILLOWS, CALIFORNIA

The Glenn County Airport site is an unlined evaporation pond that is

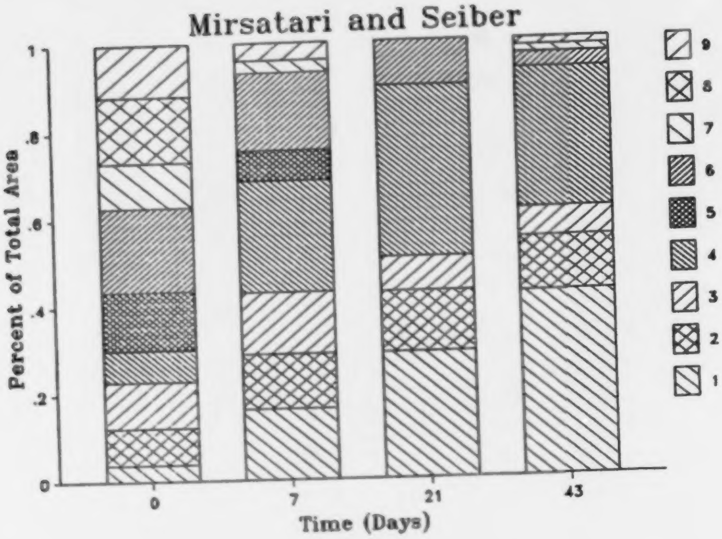

Figure 1. Changes in toxaphene profile in soil amended with alfalfa meal and maintained under anaerobic conditions. The area of each peak (1-9) is expressed as percent of total peak area.

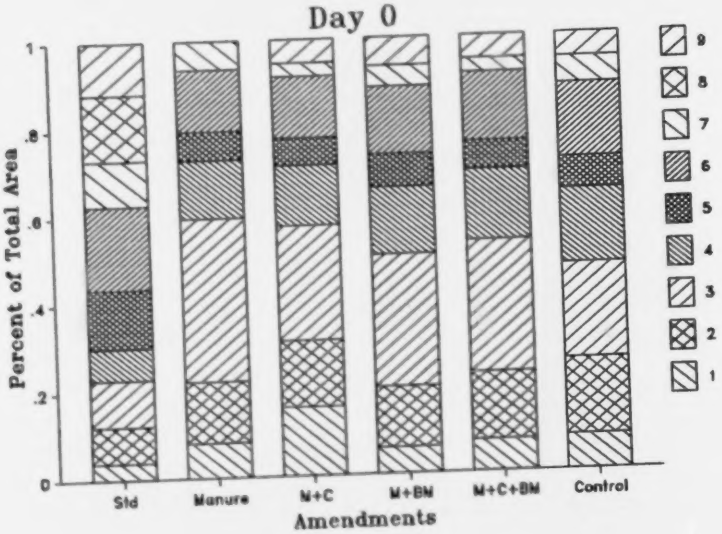

Figure 2. Toxaphene profiles in each test plot at start of biological degradation trial. Std = Technical Toxaphene standard, M+C = Manure and Corn, M+BM = Manure and Blood Meal, M+C+BM = Manure, Corn and Blood Meal, Control = no amendments.

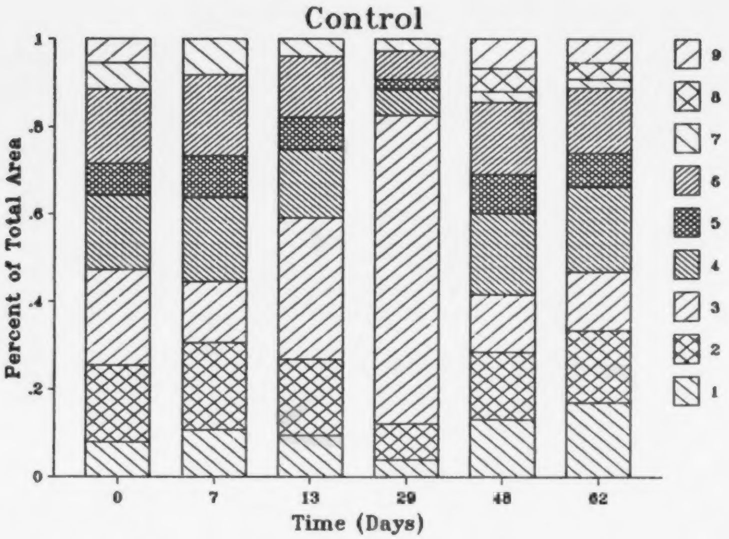

Figure 3. Change in toxaphene profiles during 62 day test for the Control plot which received no amendments.

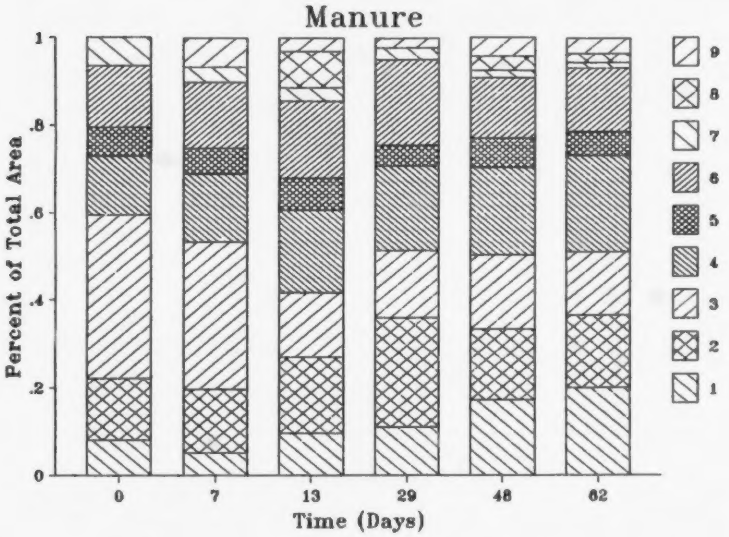

Figure 4. Change in toxaphene profiles for the plot amended with 2 lbs of manure.

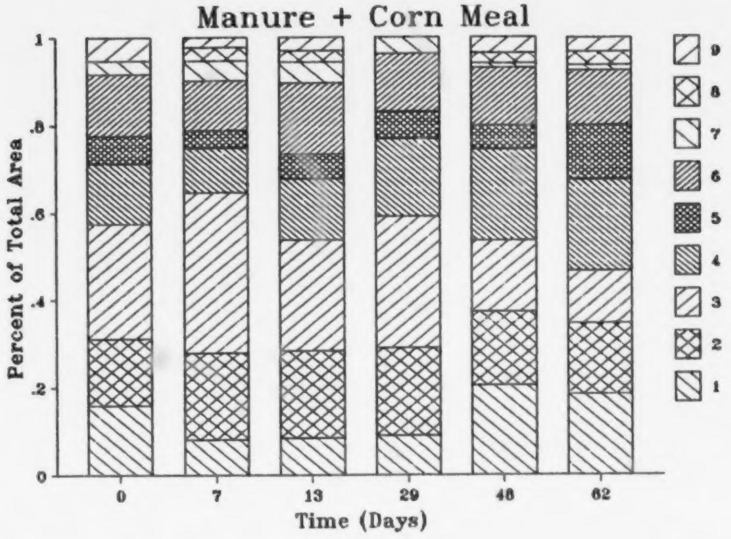

Figure 5. Change in toxaphene profile for the plot amended with 2 lbs of manure and 2 lhs of corn meal.

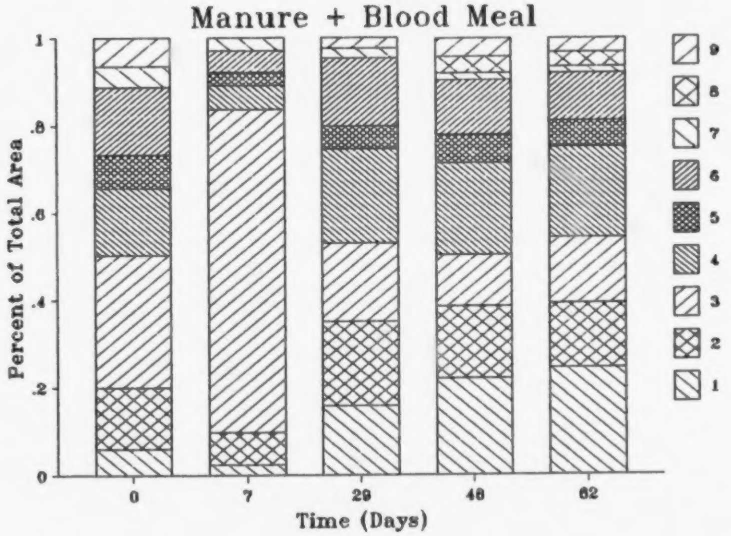

Figure 6. Change in toxaphene profile for the plot amended with 2 lbs of manure and 2 lbs of blood meal.

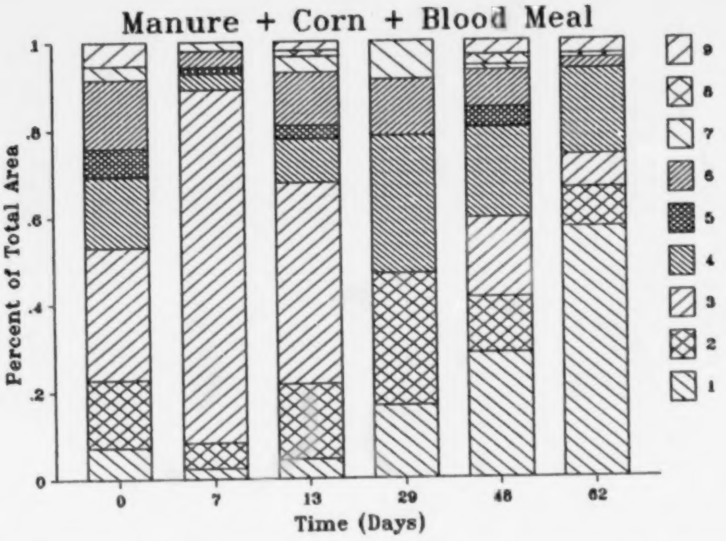

Figure 7. Change in toxaphene profile for the plot amended with 2 lbs manure, 2 lbs corn meal and 21bs blood meal.

approximately 3' deep and 60' square. It is connected to a concrete wash pad of slightly smaller size that drains into the pond. The site has been in use for over 10 years and is no longer used. The soil in the pond and surrounding areas consists of 39% clay, 42% silt and 19% sand. Initial samples of surface soil and water in the partially evaporated pond, soil in an overflow area and downwind air were taken on May 22, 1985. On September 6, 1985 additional samples were taken to a depth of 27" within the pond to determine the penetration of pesticides into the soil. The results are shown in Table II and Table III.

Due to the heavy consistency of the soil, we had to use a soil auger to take samples. The low level contamination of the first five pesticides at the 24-27" depth is quite possibly due to slight contamination of the samples by the highly contaminated surface soil. The high levels of molinate at the 9-12" and 24-27" depth cannot be explained in this way. Another site assessment study is planned for this spring to more fully characterize pesticide movement in the soil underneath the pond.

We had planned to start some of the pond treatments this fall, however delays associated with county and regulatory agency decisions forced us to wait until this coming spring. We did institute a series of winter studies to determine which conditions will promote biological degradation of the pesticides in the pond. The study was designed to test the effects of the following parameters; organic matter (including corn meal as an energy source), pH, nutrients (N and P), moisture, and anaerobic or aerobic conditions. The study is being run on site at Willows and we are testing both soil removed from the pond, and clean soil removed outside the pond to which the major pesticide contaminants have been added. The evaporation pond was covered with a tarp just before the rainy season began, and in the spring we will initiate trials in the pond based on the results of the shed study.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to Ms. Janice Myers, Mr. Mike McChesney, Mr. Jim Woodrow, and Mr. Glen Walker for their expert assistance in sampling and analysis and to Ms. Sandy Ogletree for her expert assistance in manuscript preparation.

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TABLE II. MAJOR PESTICIDE RESIDUES (ppm) IN 0-3" SURFACE SOIL, WATER AND DOWNWIND AIR
GLENN COUNTY AIRPORT -- MAY 22, 1985

Chemical	Pond Soil	Spill Area	Drainage Ditch	Air[a]	Water
Diuron	1760-3909	27.2	3.8	---	27.2
Atrazine	206-3583	3.2	0.3	5.3	3.2
Chlorpyrifos	2211-3193	10	0.4	119	10
Trifluralin	424-569	---	0.1	70	---
Me Parathion	139-392	---	0.1	4.1	---
Pronamide (Kerb)	188-323	0.6	---	4.8	---
Thiobencarb	115-187	1.5	---	---	---
p-Nitrophenol	118-187	---	---	6.8	---
Diazinon	55-100	---	---	1.7	---
Terbacil	57-92	---	---	---	---
Molinate	65-91	1.4	<0.1	49.6	---

[a] - Total air volume sampled = 60 cubic meters

TABLE III. VERTICAL CONCENTRATION PROFILE OF SIX MAJOR PESTICIDE RESIDUES
GLENN COUNTY AIRPORT -- SEPTEMBER 6, 1985

	Soil Concentration, ppm dry weight			
Chemical	0-3"	9-12"	24-27"	Water Solubility (25°C)
Atrazine	5129	143	152	33 ppm
Chlorpyrifos	1012	44	10	2 ppm
Disulfoton	1016	40	37	25 ppm (22°C)
Ethyl Parathion	1064	37	18	24 ppm
Me Parathion	38	11	3	55-60 ppm
Molinate	822	378	888	880 ppm (20°C)

A BIOLOGICAL/PHYSICAL PROCESS FOR THE ELIMINATION OF CATTLE-DIP PESTICIDE WASTES

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ABSTRACT

Extensive cattle-dipping operations are continuously carried out along the border of the United States and Mexico as part of an effort to eradicate the cattle fever tick from the United States. These operations generate large volumes of aqueous wastes containing very high levels of the insecticide and acaricide coumaphos [0,0-diethyl 0-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl)phosphorothioate]. Coumaphos is extremely resistant to degradation, with a half-life of over 300 days in neutral or acid soils. Hydrolysis of the coumaphos molecule by a strain of bacteria which produces parathion hydrolase (an enzyme which breaks down diethylthiophosphorate compounds) yielded products which were very susceptible to further degradation by U.V.-ozonolysis. The products which remained after this combined biological/physical degradation process were easily degraded to carbon dioxide and water by microorganisms in soil. Thus, laboratory results indicated that by the combined treatment of microbial hydrolysis followed by U.V.-ozonolysis, safe and effective disposal of coumaphos-containing cattle-dip wastes can be achieved. This process has been field-tested on 650 gallons of waste and was shown to be an effective waste treatment method. The problem of delivery of large numbers of viable bacteria to a remote site was overcome by growing the bacteria in the dip-vat waste itself using xylose as a source of carbon and energy and ammonium sulfate fertilizer as a nitrogen source. The microbial portion of the process required 48 hours for complete hydrolysis of coumaphos and was run at ambient temperature with vigorous aeration. Research is presently underway to simplify the process so that non-technical field personnel can effectively initiate, run, and monitor waste treatment.

The recent industrialization of the many discoveries made in biology over the last 50 years into what we now call biotechnology, combined with ever-increasing concern for the state of our environment, has stimulated interest in the use of microorganisms for the treatment of chemical wastes. Many reports have appeared over the last 5 years detailing the isolation and characterization of pure cultures of microorganisms capable of rapidly and completely degrading various xenobiotic compounds. Chlorinated hydrocarbons such as 2,4-D (3), 2,4,5-T (6), PCP (11), and chlorobenzoates (2) have been shown to be relatively rapidly degraded by pure microbial cultures. However, to date, none of these degradative organisms has been incorporated into a practical system that can be used by small source generators of agrochemical wastes. Such a system must combine cost-effectiveness with portability and ease of operation. We would like to describe our efforts to develop such a system for the elimination of waste cattle-dips containing the organophosphate insecticide and acaricide coumaphos.

The Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) and the State of Texas (TX) jointly operate a tick eradication program along the border of Mexico and Texas. The program is designed

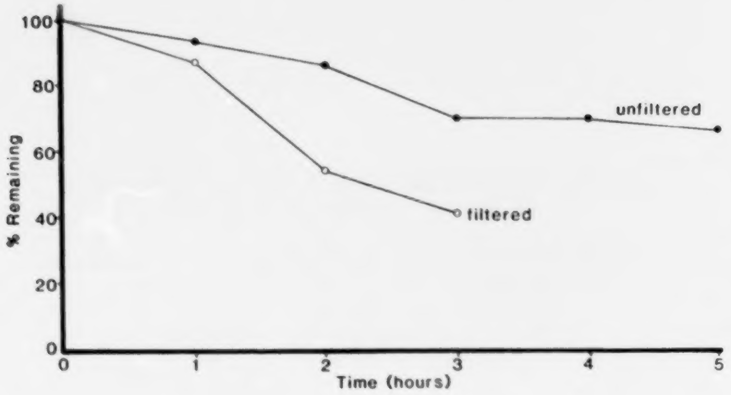

Figure 1. U.V.-ozonolysis of 1500 ppm Coumaphos

to prevent the re-introduction of the cattle fever tick (Boophilus) into the United States (U.S.). This program relies heavily upon cattle dipping operations for tick control. The primary insecticide used in these operations is coumaphos [0,0-diethyl 0-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl)phosphorothioate]. Cattle are treated by running them through long trough-like vats containing aqueous suspensions of coumaphos. Because of fouling by dirt, hair and animal wastes, these vats are emptied once a year for cleaning. There are 42 vats in this APHIS operation with an average volume of about 3,000 gallons containing 1500 to 3000 ppm of coumaphos. Thus, in one year this program generates over 140,000 gallons of aqueous wastes containing high concentrations of coumaphos. These wastes are currently put into concrete lined evaporation ponds. Since coumaphos can have a half-life of over 200 days in soils it is clear that a destructive method of coumaphos disposal would be desireable.

The technique of UV-ozonation, whereby aqueous solutions of pesticide are exposed to intense ultraviolet radiation in the presence of oxygen as a pre-treatment step prior to soil disposal, was shown to be effective in accelerating the degradation of the herbicides atrazine, 2,4-D and paraquat (4,5). The coumaphos in waste cattle-dip was very resistant to degradation by the UV-ozonation process with only 25% degradation over a 5 h period of exposure (Fig. 1). Filtering the solution prior to exposure increased the effectiveness of the process slightly, but not enough to make this process practical on a large scale. Subsequent experimentation using high levels of mechanically generated ozone has shown that coumaphos in aqueous suspension is very resistant to oxidation by ozone (data not shown).

Several laboratories had previously characterized organisms capable of hydrolyzing 0,0-diethyl phosphorothioate insecticides (7,9,10). Although originally isolated because of their ability to hydrolyze diazinon and parathion, it was subsequently determined that the responsible phosphotriesterase enzyme (parathion hydrolase) had a very broad substrate specificity and was capable of hydrolyzing a wide range of 0,0-diethylphosphorothioate compounds(1,8). Dense resting cell suspensions of the parathion degrading Flavobacterium sp. ATCC

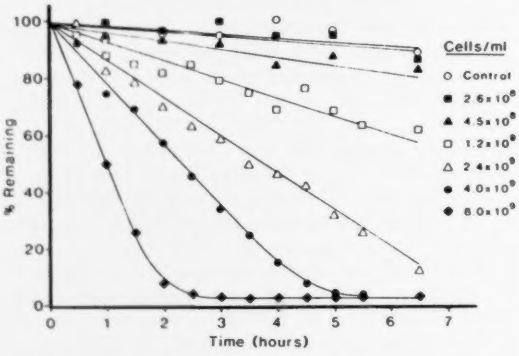

Figure 2. Microbial Metabolism of dip-vat Coumaphos

27551 (10) were capable of completely degrading the 1500 ppm of coumaphos left in a spent dip-vat sample (Fig. 2). The rate of coumaphos degradation was dependent upon cell density, with a very high cell density catalyzing complete hydrolysis within 2 hours. The reaction catalyzed by the parathion hydrolase enzyme of Flavobacterium is shown in Figure 3. The only products of this reaction are diethylthiophosphoric acid and 3-chloro-4-methyl-7-hydroxycoumarin (commonly called chlorferon).

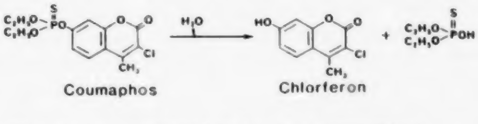

Figure 3. Hydrolysis of Coumaphos by parathion hydrolase

The chlorferon produced by the microbial hydrolysis of coumaphos was much more susceptible to destruction by UV-ozonation than was coumaphos itself (Fig. 4). This figure represents the complete microbial hydrolysis-U.V. ozonation process where 1500 ppm of coumaphos in an authentic waste sample from an APHIS dip-vat was exposed to whole cells of the parathion hydrolase producing Flavobacterium for 4 hours followed by U.V.-ozonation for an additional 3 hours. Although the chlorferon hydrolysis product was no longer detectable by high-performance liquid chromatography after 3 hours of U.V.-ozonation, most of the carbon derived from the benzene moiety of chlorferon (as measured by radioactive ^{14}C label) remained in solution, indicating that the oxidation of chlorferon was incomplete. The products of this reaction are water soluble organics with 2,4-dihydroxyacetophenone as the major product. When the U.V.-ozonated material was applied to top soil that had been biologically activated by preincubation with glucose and yeast extract the remaining ^{14}C labeled material was released as $^{14}CO_2$ (Fig. 5) indicating that the products of U.V.-ozonation of microbially hydrolyzed coumaphos were rapidly and completely oxidized by the indigenous soil bacteria. There was little $^{14}CO_2$ released from coumaphos that had been U.V.-ozonated without prior microbial hydrolysis or from material that had been subjected to microbial hydrolysis but had not been U.V.-ozonated.

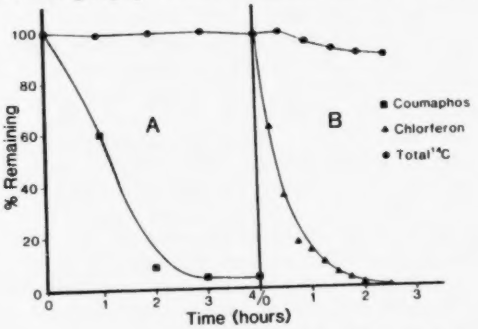

Figure 4. Microbial metabolism/U.V.-O_3 of dip-vat Coumaphos

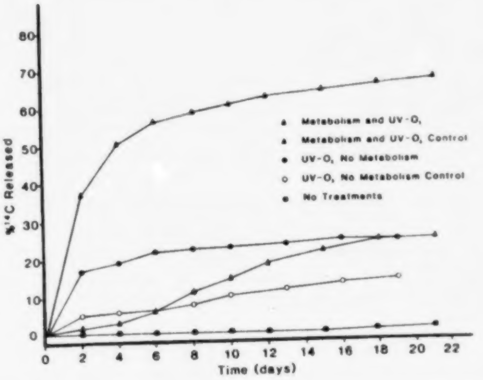

Figure 5. $^{14}CO_2$ release from treated dip-vat Coumaphos added to soil

What we have described thus far is a set of laboratory experiments in which 1 liter volumes (or less) of raw waste cattle-dip were treated. One interesting result from these experiments is that the Flavobacterium cells added to the vat waste were rapidly killed during the U.V.-ozonation process. This was not completely unexpected since many European communities use U.V.-ozonation as a water purification process (in lieu of chlorination) to control harmful microbes. This aspect of the process could become more important if we try to utilize genetically engineered microbes as a part of the process. In order to determine whether this process could be useful on a large volume of waste in more uncontrolled field conditions a preliminary field trial was set up at an APHIS cattle-dipping site. It was decided to attempt to treat 650 gallons of waste cattle dip in one compartment of a 3 compartment, 2000 gallon, stainless steel tank used in the APHIS operation for hauling water and waste dip material.

The field trial was performed in mid-August at a vat site in Laredo, TX. In order to overcome the need to deliver an extremely large number of organisms to the site we decided to add the organisms as a 1% inoculum (6 gallons of culture grown in nutrient broth plus xylose) along with 21 pounds (lb.) of xylose as a carbon source and 10 lb. of Southern States ammonium sulfate fertilizer as a nitrogen source, in order to allow growth of the organisms in the waste. The pH of the material in the tank was adjusted to between 6.8 and 7.0 by the addition of 3 lb. of monobasic potassium phosphate and 4 lb. of dibasic potassium phosphate. The temperature of the liquid varied between 36°C (98°F) and 33°C (90°F). The tank was rigorously aerated. Samples were taken at various times and diluted with methanol for later analysis of coumaphos and chlorferon. On-site determination of coumaphos levels in the tank was performed using a coloimetric assay kit (Bayvet, Shawnee, KS).

The microbial hydrolysis of coumaphos in the treated compartment was essentially complete within 48 hours (Fig. 6).

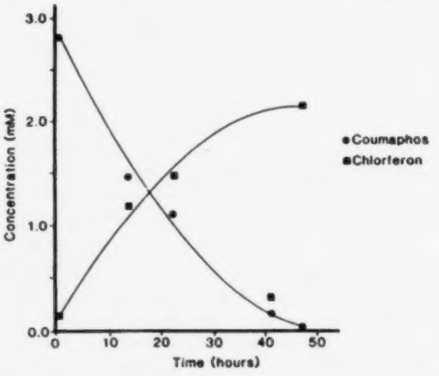

Figure 6. Microbial metabolism of dip-vat Coumaphos at the Laredo field-trial.

As expected, the chlorferon hydrolysis product accumulated. At this point aeration of the tank was stopped and ozone (generated using a Griffin ozone generator) was introduced into the tank for about 20 hours. Delayed analysis indicated that over 50% of the chlorferon was degraded during this process. Laboratory analysis on smaller volumes of material had indicated that chlorferon was very susceptible to oxidation by mechanically generated ozone in the absence of U.V. light.

The results of the Laredo field trial indicate that the method of microbial hydrolysis-U.V.ozonation is very effective in the elimination of waste coumaphos. Some technical problems that hampered our effort at Laredo were a lack of familiarity with the site, difficulties in delivering fresh, actively growing bacterial cultures to a remote site, and lack of the analytical chemistry capability to follow the course of the degradation process. None of these problems are insurmountable. A second, more extensive field trial is planned for the late spring of 1986. Among the things to be tested are alternative methods for the delivery of active cultures to a remote location. The delivery of adequate amounts of ozone into the hydrolyzed material was also a problem during this trial. However, this is strictly a problem of engineering existing technology to fit this unique purpose and should pose no great difficulty to the development of this process. Large scale U.V.-ozonation units for the treatment of extremely large volumes of drinking water already exist and the technology behind such systems should be directly applicable to our purposes.

Based on the one preliminary field trial described here, the cost to completely eliminate the waste from one 3,000 gallon vat would be less than $500(US). This cost is based on a price of $2.49/lb for xylose and $0.12/lb. for ammonium sulfate. We used an analytical grade of potassium phosphate but a much less costly source of phosphate could be found. Much work needs to be done to determine the optimum amounts of the above chemicals needed to run the system cost effectively. With additional research many of the parameters on the biological portion of the system could be optimized leading to large reductions in costs. The $500/vat estimate also includes an estimated cost of $12/week to run the U.V.-ozonation unit at $0.05/kilowatt hour.

What does the future hold for the treatment of agrochemical wastes? Recent research has shown that many types of pesticides are directly ammenable to destruction by U.V.-ozonation (4,5). However, the capital cost of purchasing the U.V. ozonation unit is somewhat high. Perhaps pesticide distributors will be able to purchase portable units and provide their customers with waste removal as a service. On the biological front the future is very bright as more laboratories begin to explore the biochemistry and molecular biology of pesticide degradation by plants, animals, and microbes. We have isolated and partially purified an enzyme which degrades the N-methylcarbamate insecticide carbofuran. Like the parathion hydrolase so well characterized by Munnecke and his co-workers (8), this enzyme is a hydrolase with a broad substrate specificity so that it can also hydrolyze carbaryl and aldicarb. Unlike parathion hydrolase this enzyme is unstable in crude extracts, but once partially purified it, too, exhibits remarkable stability. The pesticide hydrolase enzymes characterized so far are active over a broad range of pH and temperature. As more research is conducted we are sure similar enzymes will be found for acylanilide herbicides (such as alachlor and metolachlor) and dithiophosphorate insecticides (such as Terbufos and Dyphonate). Such enzymes might be distributed as packets, containing enzyme and buffer, that the farmer or applicator could add to containers and tanks to assure overnight degradation of waste pesticides in rinsates. While such enzymes do not totally degrade pesticides, the one step hydrolysis they catalyze does destroy the biological activity of the compounds (thus, in the case of insecticides greatly reducing their toxicity) making them safer to dispose of or to store until enough has accumulated to make it practical to subject them to further destructive techniques such as U.V.-ozonation or incineration.

The techniques associated with biotechnology may be used to increase the production of microbial enzymes or to change the range of compounds that an enzyme can degrade. As more research is done in the area of biological waste management further advancements are anticipated. What is needed is a new level of committment from manufacturers, users and government to finance research and to develop the network of research scientists, engineers and technicians required to take basic research and develop practical systems that can be used in the field. The level of protection demanded by the general public and embodied in RCRA should not be viewed as an obstacle to progress but as a goal that can and will be obtained.

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BIOLOGICAL AND CHEMICAL DISPOSAL SYSTEMS FOR WASTE PESTICIDE SOLUTIONS

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ABSTRACT

Acidic and alkaline trickling filter systems were assessed for biological and chemical decomposition of pesticides. A disposal pit (6.1 m x 6.1 m x 1.2 m) was filled with coarse grade limestone for promotion of alkaline hydrolysis, another with acid waste material from a strip mine operation to promote acid hydrolysis. A network of 2-in perforated PVC pipe suspended over the filter material and a circulation pump facilitate distribution of the test solutions. The treatment systems were inoculated with indigenous pesticide-decomposing bacteria to enhance degradation.

Microbial counts have been determined over time and compared with pesticide concentrations (via gas chromatography). Compounds tested include alachlor, atrazine, butylate, cyanazine, linuron, metolachlor, metribuzin, pendimethalin, and trifluralin. All but granular formulations have been used. Greater degradation rates were generally observed in the acid system (up to 30% per day). Degradation rates for the alkaline disposal system averaged 2.5% per day.

INTRODUCTION

Pesticide applicators and dealers are faced with a waste disposal problem which may vary according to the size and type of operation. Waste-water from vehicle washing, spray or nurse tank rinse-water, haulback solutions, facility runoff, spilled materials, obsolete or unidentifiable chemicals, containers and incompatible mixtures are all recognized sources of waste pesticide solutions (6).

LITERATURE REVIEW

The use of toxic chemical compounds in agriculture has created problems of biological and environmental concern since the pesticides employed may not be totally specific and degraded to a harmless state. The concern for potential biohazards which may exist from yearly application was acknowledged in a study carried out by the Association of State Universities and Land Grant Colleges and United States Department of Agriculture (20).

The Fate of Pesticide in the Soil

Pesticides applied to the soil or which ultimately reach the soil may be acted upon physically, chemically, or biologically. All result in a change of structure and/or toxicity (2, 17). Physical losses of pesticides from the soil include: wind and water erosion, adsorption to soil particles such as organic matter, leaching, and volatilization. Chemical mechanisms of transformations are much less understood and only recently are being proposed as major pathways of pesticide degradation. In addition, chemical transformations may contribute essential stages to principally biological decomposition pathways (16). Alkaline hydrolysis, reduction, elimination, decarboxylation, oxidation, and isomerization are among the reactions that may occur (12). Photodecomposition is a combination of physical and chemical transformations. The majority of pesticides are subject to photodecomposition and this may be the prominant degradative mechanism of pesticide vapors. However, it is not significant when the material is soil incorporated or on crops and crop residues (14).

Soil microorganisms and plants are responsible for biological pesticide transformations. Transformations by plants (such as plant uptake of herbicides) result in a decrease of pesticide concentrations (1, 13). Indigenous microbial populations of bacteria and fungi play a key role in pesticide biodegradation (2). Alexander (2) and Atlas and Bartha (8) have categorized microbial transformations of pesticides on the basis of the end-product formed: detoxification, degradation, conjugation, complex formation, activation, defusing, and a change in the spectrum of toxicity.

Rates and mechanisms of pesticide degradation are dependent on the environmental conditions (15). Biological, chemical, and physical transformations cannot be separated since exclusion of one will alter rates and pathways of the decomposition process (15, 17).

The pesticides used in this study were selected on the basis of their popularity in Illinois agriculture systems. For information on the degradation of alachlor (2-chloro-2',6'-diethyl-N-[methoxymethyl] acetanilide), atrazine (2-chloro-4-[ethylamino]-6-[isopropylamino]-s-triazine), butylate (s-ethyl diisobutylthiocarbamate). cyanazine (2-[[4-chloro-6-(ethylamino)-s-triazin-2-yl]amino]-2-methylpropionitrile), linuron (3-[3,4-dichlorophenyl]-1-methoxy-1-methylurea), metolachlor (2-chloro-N-[2-ethyl-6-methylphenyl]-N-[2-methoxy-1-methylethyl]acetamide), metribuzin (4-amino-6-tert-butyl-3-[methylthio]-as-triazin-5[4H]-one), pendimethalin (N-[1-ethylpropyl]-3,4 dimethyl-2,6 dinitrobenzenamine), and trifluralin (2,6-dinitro-N,N-dipropyl-4-trifluoromethylaniline) please consult the following sources: Brown (9), Cripps and Roberts (11), Herbicide Handbook of the Weed Science Society of America (7), and Knuesli et al. (18).

Pesticide Disposal Practices

The mismanagement of generated waste pesticide materials may cause potential environmental problems: the contamination of ground and surface water via runoff from the site of pesticide mixing, and/or discharges of chemical spray tank rinsates into streams (4, 6). The difficulty of implementing regulatory measures for the proper disposal of waste pesticide materials has resulted in certain illegal disposal practices such as rinsing spray tanks on open lots without providing containment, improper disposal of the rinsate solutions, dumping excess spray solutions and tank rinsings along fence rows, and discharging pesticide-contaminated waste-waters into ditches and streams (6).

Various methods of treatment and disposal of waste pesticide solutions have been proposed and evaluated. Such methods include land disposal (land cultivation, soil mounds and pits), evaporation basins and lagoons, chemical treatments, physical treatments (adsorption and reverse osmosis), biological treatment (trickling filters and activated sludge) and incineration (4).

From 1977 to 1979, Iowa State University conducted an experimental study of pesticide decay by using 56 minipits (plastic garbage cans), 2 macropits, and 4 micropits (5). The macropits were designed for the more practical aspect of waste pesticide disposal. Essentially, they were soil pits with a top or middle layer of rock. Neither circulation nor aeration occurred, thus representing static systems. These pits were also uncontrolled since timing, amount, and type of waste materials to be disposed were not planned, but merely monitored over time. The pH, chemical constituents, and microbial populations were determined. However, the role of the microbial populations in pesticide decomposition was not delineated.

In a recent project at Southern Illinois University-Carbondale, the disposal of atrazine and trifluralin was assessed in an acid and alkaline trickling filter system (21). Trifluralin phytotoxity was observed to decline to 3 and 5% in the acid and alkaline disposal pits, respectively, following 21 days of incubation. Atrazine phytotoxicity fell to 23% in the acidic pit after 21 days of incubation but remained constant (68 to 70%) in the alkaline pit. However, herbicide concentrations were not determined. Population counts of herbicide decomposers demonstrated a one to two log increase in the alkaline pit following 5 to 9 days of incubation. The acidic pit showed two peaks in the counts of herbicide decomposers after

1 and 14 days of incubation. Significant cubic and quadratic functions were determined for herbicide phytotoxicity and decomposer counts versus time in the acid and alkaline disposal pits, indicating a direct effect by the microbial population on herbicide activity.

The objectives of this study were: to evaluate a variety of herbicides commonly used in high volumes in Illinois for disposal in acid and alkaline trickling filter systems and to compare numbers of pesticide degrading microorganisms with pesticide degradation.

MATERIALS AND METHODS

Description of Pesticide Disposal Pits

During the summer of 1981, trickling filter disposal pits were constructed at the Southern Illinois Fruit Station, Carbondale, Illinois in an argillic (Bt) horizon of a Weir silt loam (fine, montmorillonitic, mesic typic ochraqualf) (Figures 1 and 2). The dimensions of the pits are 6.1 m x 6.1 m x 1.2 m or 44.7 m^3. The pits are side by side but separated by a 1 m clay barrier and surrounded by a 61 centimeter (cm) berm. In one pit, the filtering medium is coarse grade limestone (alkaline pit). This creates a neutral to alkaline environment facilitating chemical hydrolysis and microbial growth. In the adjacent pit, the medium is acid mine gob obtained from a nearby coal strip mine, creating a highly acidic and strongly anaerobic system (acid pit). Each pit has a single well equipped with a 248 kilogram meter squared per cubic second ($kg \cdot m^2 S^3$) sump pump discharging the dilute pesticide solutions through a network of 5.1 cm PVC perforated pipe. The flow rate of the pumps was rated at 10.4 (m^3 hr^{-1}). Because of high porosity of the limestone, the pesticide solutions were discharged in a continuous mode in the alkaline pit. The very low porosity of the gob material only permitted intermittent discharging (at 30 minute (min) cycles) of the pesticide solutions.

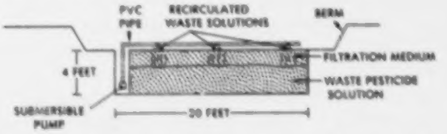

Figure 1. Side view of pesticide disposal system.

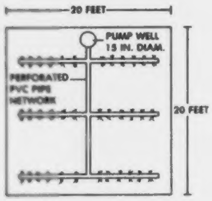

Figure 2. Overhead view of pesticide disposal system.

Isolation of Pesticide Decomposing Microorganisms

Soil samples, as a source of herbicide decomposing microorganisms, were taken from the soils adjacent to the acid/alkaline trickling filter system. The soil samples were composited and sieved to a two to five millimeter (mm) particle size followed by storage at 4 degrees celcius (C) until used.

The isolation of herbicide decomposers utilized the soil perfusion method described by Collins and Simms (10). This system was used as an enrichment technique. Super Floc 127 (American Cyanimid), a soil stabilizer, was added (0.8% dry weight basis) to each 100 gram (g) soil sample. Tap water was added to bring the mixture to a smooth paste consistency. The soil-paste was sieved, obtaining five to seven mm crumb-like particles. The particles were air dried for two days at room temperature.

Following drying, 20 g of the stabilized particles were placed in a perfusion flask containing 250 milliliters (ml) of tap water. A total of 18 flasks were perfused for 24 hours. The perfusates were discarded and replaced with 200 milligrams per liter (mg L^{-1}) solution of alachlor, atrazine, butylate, cyanazine, linuron, pendimethalin, metolachlor, metribuzin, or trifluralin, plus 30 ml of pesticide grade methanol (two flasks per treatment). The experimental units were run for 14 days in the dark at room temperature under optimal aeration and suction.

The perfusates were analyzed initially and every four days thereafter for herbicide degrading microorganisms employing a differential medium (19) modified from Thorton's agar. Each of the herbicides being tested was the sole carbon source in the growth media. A 0.1 ml sample from each perfusion flask was plated on the appropriate differential medium. The appearance of red or blue colonies allowed for the identification and subsequent culturing of the desired microorganisms.

Disposal Pit Inoculation

Isolates of herbicide decomposing bacteria were maintained on fresh plates containing 200 mg L^{-1} of the appropriate herbicide. One to two isolates of each type of herbicide decomposer were grown in 1 L of Thorton's medium and used to innoculate each disposal pit prior to herbicide additions. Samples of the inoculum were plated on the differential media as previously described for an initial herbicide decomposer count.

Loading of the Disposal Pits

On October 4, 1985, each disposal pit was loaded with 4.7 L Aatrex (40.8% a.i.), 4.4 L Bladex 4L (43% a.i.), 1.9 L Dual 8E (86.4% a.i.), 1.6 L Lasso (45.1% a.i.), and 1.7 L Sutan+ (6 lb/gal a.i.). The water level was maintained at approximately 51 cm in the alkaline pit and 40 cm in the acid pit.

A second inoculation and herbicide loading of the disposal pits were made on November 7, 1985. Each pit received 1 kilogram (kg) Lexone DF (75% a.i.), 4L Lorox (41% a.i.), 0.4 L Prowl (42.3% a.i.), and 4.8 L Treflan (41.2%). Due to extreme amounts of rainfall throughout November, the pump was removed from the alkaline pit on November 12 and from the acid pit November 17.

Sampling and Biological/Chemical Analyses

Composit water samples were taken from each PVC pipe at a schedule of 1, 4, 7, 10, 13, 16, 19, 22, 25, and 28 days. Duplicate 125 ml samples were collected in sterile plastic bottles. Total bacteria counts, herbicide decomposer counts, herbicide concentration, and pH were determined for each sample.

Total bacteria counts were made by plating the water samples on Thorton's medium. Herbicide decomposer counts were determined by employing the various differential media as previously described.

The pH of the water samples was determined with a Fisher accumet pH meter, model 620.

To extract the herbicides, ten milliters of sample were added to a 50 ml Erlenmyer flask followed by the addition of 20 ml diethyl ether. The mixture was shaken for 5 min on a rotary shaker and transferred to a 250 ml separating funnel and allowed to stand for 15 min. The water layer was then removed and the ether fraction was collected for analysis via gas-liquid chromatography.

For the determination of each herbicide, a 1 microliter (μl) sample was injected into a Varian 3700 series gas chromatograph equipped with a flame ionization detector. Nitrogen was used as the carrier gas (flow rate 30 ml min^{-1}) while air (flow rate 300 ml min^{-1}) and hydrogen (flow rate 30 ml min^{-1}) provided for flame ionization. The herbicides were separated on a 1.8 m x 4 m glass column packed with PT 5% SE-30 on Chrom W-HP, 80 to 100 mesh (Alltech Associates, Deerfield, IL). The column temperature was maintained at 180 C while the injector temperature was maintained at 210 C and the detector temperature was set at 230 C. Range and attenuation setting was set at 4 x 10^{-11}. A 200 microgram per milliliter ($\mu g\ ml^{-1}$) standard of each herbicide was used as a reference. The concentration of each herbicide in the water samples was then determined as described by Standard Methods of Water Analysis (3).

Statistical Analysis

An analysis of variance and trend analysis of total and herbicide decomposer bacteria counts over time were conducted. Percent decay curves were determined for applied-herbicides. Statistical analysis was performed by an IBM 370 computer using the SAS statistical package.

RESULTS AND DISCUSSION

Disposal of Corn Herbicides

Total bacteria and average herbicide decomposer population counts for corn herbicides applied to the alkaline and acid disposal systems are summarized in Figures 3 and 4, respectively. Total bacteria numbers represent the mean of seven samples. Decomposer counts represent the mean of alachlor-, atrazine-, butylate-, cyanazine-, and metolachlor-decomposers. The value for each type of herbicide decomposer is the mean of seven samples. Herbicide concentrations (microgram per liter, μg L^{-1}) for alachlor + metolachlor, atrazine, and butylate in the alkaline and acid systems are presented in Figures 5 and 6, respectively.

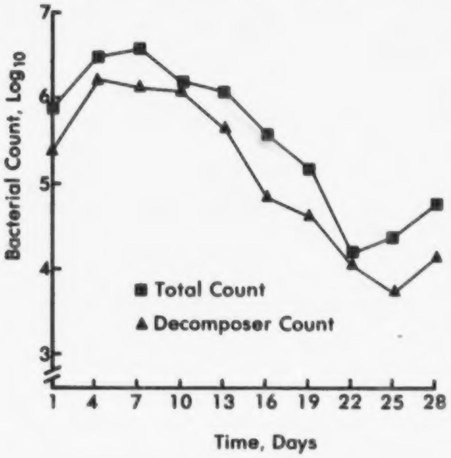

Figure 3. Total and decomposer counts for corn herbicides applied to the alkaline disposal system.

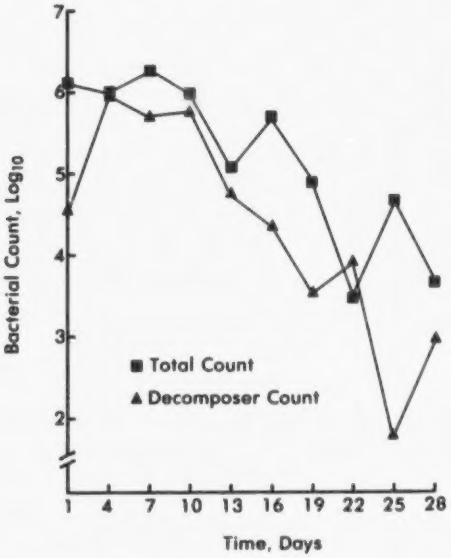

Figure 4. Total and decomposer counts for corn herbicides applied to the acid disposal system.

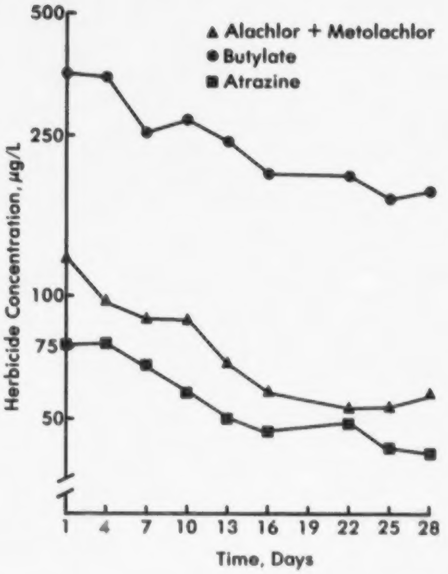

Figure 5. Corn herbicide concentrations in the alkaline disposal system.

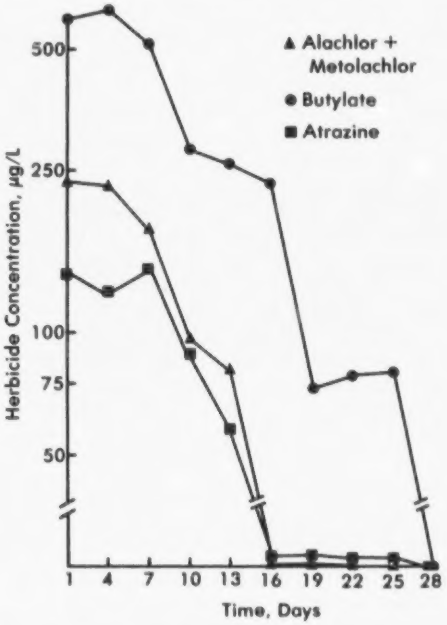

Figure 6. Corn herbicide concentrations in the acid disposal system.

Total and decomposer counts responded similarly to the addition of herbicides to both pits. The population counts initially increased, with the highest values occurring between days 4 and 10. In the alkaline pit, counts decreased throughout the remainder of the trial with a slight gain at days 25 and 28 for total bacteria and day 28 for decomposer bacteria. In the acid pit, the overall population counts decreased. However, secondary and tertiary peaks occurred at days 16 and 25 for total bacteria and days 22 and 28 for decomposer bacteria. These non-primary peaks may be the result of several influences. The microbial response to desorbed herbicide from the gob material and/or initial breakdown products as new substrates or changes in pH are likely candidates.

According to analysis of variance, total counts were significant at $P<0.05$ for the alkaline pit and at $P<0.1$ for the acid pit. Trend analysis showed these relationships over time to be non-significant in the acid pit and quartic ($P<0.05$) in the alkaline pit. The analysis of variance of decomposer counts was also significant at $P<0.05$ and quartic over time ($P<0.05$) by trend analysis.

In the alkaline system, herbicide concentrations generally decreased throughout this first experiment. Decay rates were 3% per day for alachlor + metolachlor (r=0.904), 2.5% per day for atrazine (r= 0.951), and 3% per day for butylate (r= 1.133). Herbicides in the acid system degraded more readily. Initial concentrations were two fold that of the alkaline system and final concentrations were nearly non-existant. Minor increases (less than 30 μg L^{-1}) in concentrations are likely due to either inherent error in the sampling and preparation for gas chromatography analysis, or desorption of the herbicide from the gob material. Decay rates were 30% per day for alachlor + metolachlor (r=1.005), 28% per day for atrazine (r= 0.897), and 19% per day for butylate (r= 0.824).

Disposal of Soybean Herbicides

Total bacteria and average herbicide decomposer bacteria counts for soybean herbicides applied to the alkaline and acid disposal pits are given in Figures 7 and 8 respectively. Total bacteria counts represent the mean of seven samples. Decomposer counts are the average of linuron-, metribuzin-, pendimethalin-, and trifluralin-decomposer bacteria. There were seven samples for each specific herbicide decomposer. Herbicide concentrations (μg L^{-1}) of metribuzin and pendimethalin for alkaline and acid systems are illustrated in Figures 9 and 10, respectively.

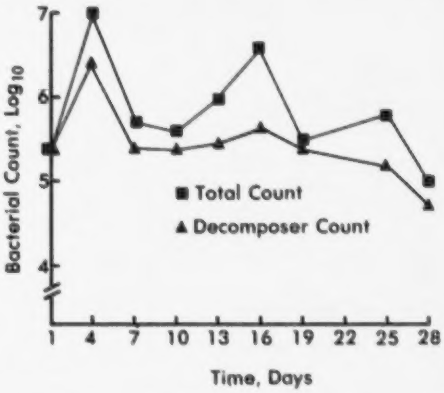

Figure 7. Total and decomposer counts for soybean herbicides applied to the alkaline disposal system.

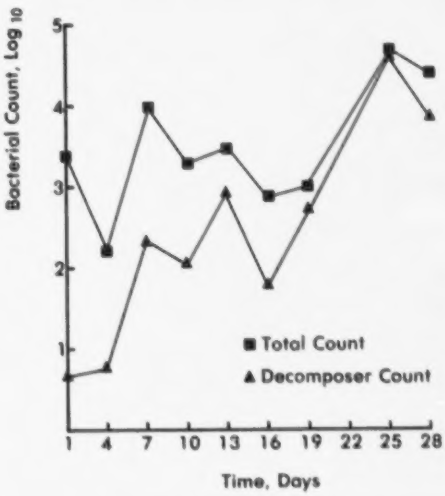

Figure 8. Total and decomposer counts for soybean herbicides applied to the acid disposal system.

Total and decomposer counts demonstrated tri-modal curves for both disposal systems with peaks occurring approximately 10 days apart. This cyclic growth pattern is a likely microbial response to the addition of the herbicides. The secondary and tertiary peaks are the result of the microbial population adjusting to new and perhaps

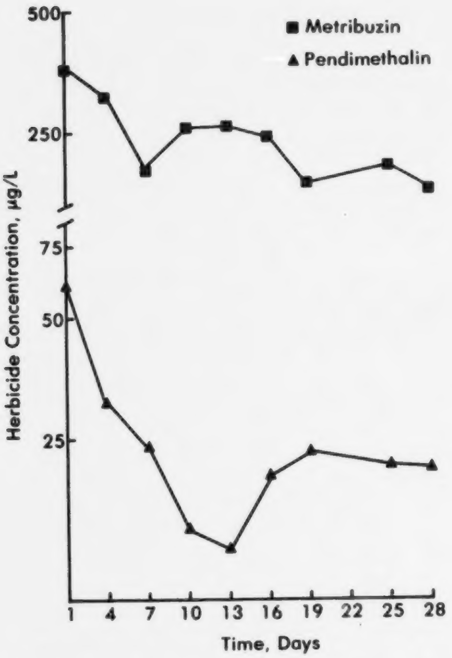

Figure 9. Soybean herbicide concentrations in the alkaline disposal system.

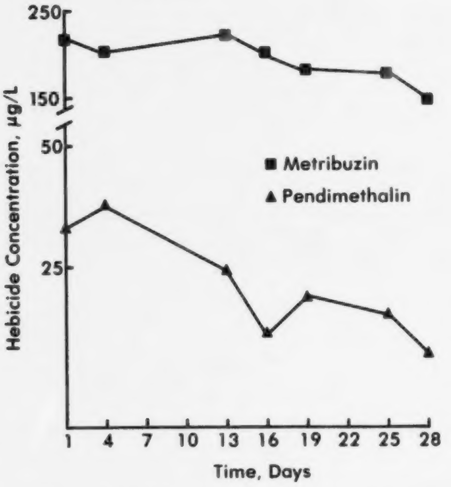

Figure 10. Soybean herbicide concentrations in the acid disposal system.

more complex substrates as degradation proceedes. Microbial counts for the acid pit increased after day 16. This is in response to a more favorable pH. The disposal systems were inundated with rain. The pumps had to be removed to prevent water damage. Under the static conditions, the pH of the trench water increased, becoming more favorable for microbial growth.

Analysis of variance showed all bacteria counts to be significant at $P<0.05$, and these relationships (over time) were quartic according to trend analysis ($P<0.05$).

Herbicide degradation in both disposal pits was very slow, and may be related to the cooler temperatures observed for November. Metribuzin decayed at a rate of 2% per day ($r=0.817$) in the alkaline pit and 1% per day ($r=0.858$) in the acid pit. Slight increases (less than 54 µg L^{-1}) in metribuzin concentration occur in the alkaline pit. Again, this may be due to either desorption or inherent error in preparation for gas chromatography analysis.

CONCLUSIONS

The load capacity of these systems is dictated by the size of pits constructed. The estimated capital and operating costs (1985 dollars) are $6,000 and $2,500/yr., respectively. Some advantages to these systems are that they are effective on most commonly used herbicides and insecticides in Illinois, and further disposal of residues is not required. Another desirable aspect is that the skills required to construct and maintain either of these systems are available in any agricultural community. Persistance of triazines in the alkaline system, low infiltration rates of waste solutions through the acid material, and necessity of noncorrodable pumps are the disadvantages to these systems. Life expectancy, identification of major breakdown products contained in the systems and of volatilized compounds should be established prior to use of this technology for the treatment and disposal of pesticide wastewater. Current trends in state regulation of in-ground disposal systems may cause them to become obsolete. However, this technology can be readily incorporated into an above-ground system as illustrated in Figure 11.

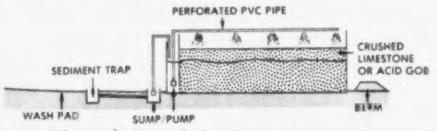

Figure 11. Proposed above-ground pesticide disposal system.

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PESTICIDE RESEARCH WORKSHOP SUMMARY
(Research Workshop on the Treatment/Disposal of Pesticide Wastewater)

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ABSTRACT

A research workshop on the treatment/disposal of pesticide wastewater generated by the agricultural application of pesticides was held at the U. S. Environmental Protection Agency's Andrew W. Breidenbach Environmental Research Center in Cincinnati, Ohio on July 30-31, 1985. The purpose of this workshop was to address issues regarding the effectiveness of current state-of-the-art capabilities, identification of emerging techniques or technologies that may be applicable along with technologies being applied in other areas, and the need for research efforts capable of providing results in a 3- to 5-year time frame as they pertain to the treatment/disposal of dilute pesticide wastewater.

The format of the two-day workshop included the sixty-one invited participants representing an appropriate cross-section of interests and expertise attending at their own expense. Participants were mostly individuals actively involved in related research as well as adequate representation from the user and regulatory community to assure that the problem and candidate solutions were kept in proper perspective. The first day plenary session addressed twelve technologies as follows: (1) pesticide rinsewater recycling, (2) granular carbon adsorption, (3) UV-ozonation, (4) small-scale incineration, (5) solar photo-decomposition, (6) chemical degradation, (7) evaporation, photodegradation and biodegradation in containment devices, (8) genetically engineered products, (9) leach fields, (10) acid and alkaline trickling filter systems, (11) organic matrix adsorption and microbial degradation, and (12) evaporation and biological treatment with wicks. The second day divided the participants into two workgroups. Workgroup A was entitled, "Physical/Chemical Treatment and Recycling" and Workgroup B was entitled, "Biological Treatment & Land Application."

A publication entitled, "Proceedings: Research Workshop on the Treatment/Disposal of Pesticide Wastewater" resulted from this research workshop. The publication is a compilation of the sixteen speaker's abstracts, both work group results and a conclusion with recommendations. While a brief summary was presented at the 1986 National Workshop on

Pesticide Waste Disposal, the full Proceedings can be obtained through the National Technical Information Service (NTIS). Please refer to EPA 600/9-86-001 and NTIS Accession No. PB 86-167004/AS.

Physical/Chemical Treatment and Recycling

Workgroup A considered six technologies which included 1) pesticide rinsewater recycling, 2) granular activated carbon adsorption, 3) UV-ozonation, 4) small-scale incineration, 5) solar photodecomposition, and 6) chemical degradation. Sub-workgroups were organized to evaluate each of these technologies. Each sub-workgroup was asked to address three aspects of its assigned technology: state-of-the-art capabilities, emerging technology and (or) technology transfer opportunities, and research needs over the next three to five years. In addition, information was developed on current applications, potential difficulties, cost, ease of operation, size, and shortcomings. Each technology was ranked on its suitability for on-site farm disposal. These findings were then discussed by the full workgroup and modified as necessary to meet the consensus of opinion.

Two processes were considered proven technologies that are in use and the techniques are available. These are recycling and granular activated carbon adsorption.

Recycling pesticide rinsewater has been used extensively in the past by aerial applicators as a method of reducing or minimizing the amount of wastewater that must be managed. Only the volume of spray needed for a spray operation is mixed and any rinsewaters from containers are used as diluents for subsequent spray solutions. Care must be exercised in avoiding mixing any combination of active ingredients that could result in subsequent crop damage or illegal residues.

Granular activated carbon adsorption has been used in certain industrial situations as a means of removing organic chemicals from water. It has been used on a very limited basis for pesticide rinsewater. It can handle large volumes of wastewater in a relatively short time. The process generates a carbon-pesticide residue that subsequently must be treated/ disposed by additional methods.

UV-ozonation and chemical degradation were considered transfer technology opportunities that require further development before full implementation can be achieved. The remaining two technologies were determined to be in the early development stage (emerging technology) and would require research and evaluation before they would be available.

Biological Treatment and Land Application

Workgroup B also considered six technologies: 1) evaporation, photodegradation and biodegradation in containment devices, 2) genetically engineered products, 3) leach fields, 4) acid and alkaline trickling filter systems, 5) organic matrix adsorption and microbial degradation, and 6) evaporation and biological treatment with wicks. As in Workgroup A, sub-workgroups were organized for each of these technologies and the same evaluation process was followed.

It was found that two technologies were currently in use and available for managing dilute pesticide wastewater. These are 1) evaporation, photodegradation in containment devices, and 2) leach fields. While these two technologies are not endorsed by EPA or USDA, both technologies were reported as existing technologies.

Universities and other research facilities have been employing evaporation, photodegradation and biodegradation in containment devices (often referred to as "pits") to treat pesticide wastewaters for over 15 years; however, this method is not widely utilized for several reasons. These include such unknowns as the potential for the treatment to further produce hazardous wastes, uncertainty of the science and the product results and lack of understanding of the treatment process on specific pesticides.

Leach fields are being used by many small fruit farms in New York. However, additional information is needed to fully assess the groundwater pollution potential posed by this system and it appears that the State of New York is re-evaluating the acceptability of this technology.

The remaining four technologies, found to be emerging technologies, will require three to five years of research and development before they can be expected to be available.

SUMMARY

There was a consensus of opinion that an immediate research effort was needed to:

1. Address those research needs identified for the currently available, proven technologies such that utilization of these methods can at least be maximized on an interim basis.
2. Conduct preliminary assessments of the effectiveness of the emerging technology opportunities and rank them for further development. Consider the combination of technologies as part of this effort.
3. In priority order, address the identified research needs for the emerging technology opportunities.

In addition, it was generally agreed that a combination of several technologies probably offers one of the best opportunities for overcoming some of the shortcomings of each individual method. Overriding issues that ultimately will determine the widescale acceptance of any disposal technology at the farm or commercial applicator level are effectiveness, cost, ease of operation, durability, safety, and mobility.

Reference:

Bridges, J. and Dempsey, C., "Proceedings: Research Workshop on the Treatment/Disposal of Pesticide Wastewater." U. S. Environmental Protection Agency, EPA 600/9-86-001, January 1986.

DIRECT INJECTION AS A RINSEWATER MINIMIZATION TECHNOLOGY

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Stillwater, OK 74078

Direct injection of pesticides into a spray system is a potential means of minimizing rinsewater. For the purpose of this paper, direct injection is defined as "Any scheme by which pesticide concentrates are metered, injected or introduced and mixed, by whatever means, into a sprayer pressure system directly from one or more shipping containers or other specialized containers and at a point in the system just before or near where the mixture would be discharged from the spray nozzles". A direct injection system (Figure 1) is essentially two systems -- a diluent system and a pesticide concentrate system, with the tank (the one we now use to put spray mixtures into)used only for diluent. Ideally, nothing would be pre-mixed and whatever is introduced into the pressurized lines would be metered, measured, introduced, mixed and controlled by an onboard control unit. The control unit would monitor the ground speed, the flow from the diluent tank and from one or more concentrate tanks and would then actuate the appropriate control valves in response to the incoming signals or to any pre-set or prescribed values. The control unit could permit the introduction of pesticide concentrate either in response to ground travel or at a

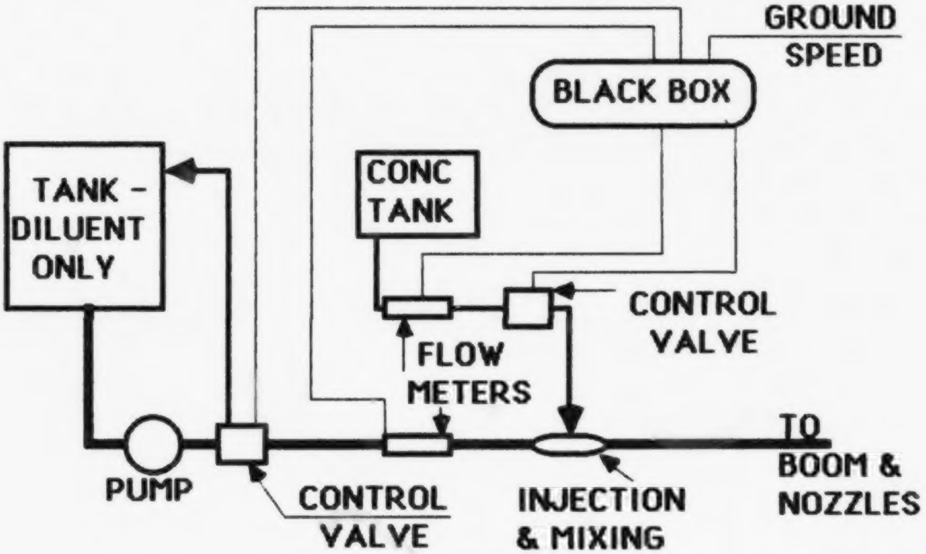

Figure 1. Schematic Diagram of Direct Injection System.

pre-determined constant flow rate. In any event, for such a system, when the flow of pesticide concentrate into the boom supply line would be stopped, shortly thereafter, only diluent would flow from the spray nozzles and there would be no left-over mixtures in a tank to dispose of at the end of a spraying operation.

Conceptually, this is a very simple idea and has several advantages to offer over conventional systems. The most obvious advantage would be to eliminate or significantly reduce the generation of un-used mixtures. Other significant benefits would be to reduce human exposure and the hazards associated with measuring, mixing and the transfer of mixed spray materials, as well as providing a quick, easy and thorough method of cleaning a sprayer immediately following each use -- something that is not now commonly and routinely done with existing equipment. This essentially automatic maintenance procedure would, by itself, almost certainly result in improved sprayer reliability. All of these contribute to direct economic benefits in terms of chemical saving and reduced application and waste disposal costs.

On the other hand, such systems would, of necessity, be more complicated, and consequently, if properly designed and thoroughly field tested, would be more expensive -- and likely by quite a bit. It is not clear that the market will stand an order of magnitude increase in the selling price -- even though the units demonstrate the desired and needed performance. More skill and training would be required to operate such equipment properly. Such systems may also tend to be product specific and some flexibility in use may be sacrificed, compared to the sprayers we now use that are supposed to handle all compounds that are put into them.

A few commercial direct injection systems similar to the one described already exist, though they may use different arrangements to acomplish the desired tasks. The basic notion of direct injection is not new, as work on such systems was done as long as 20 years ago by Nelson (1), Harrell (2) and Peck (3) and at a time when there was no great interest in or generally accepted need for such devices. More recent work has been done by Vidrine (4), Kennedy (5), Larson (6), Reichard (7) and Ladd (8) some of whom used microprocessor technology in the control systems. Thus, there has been and is now a fair amount of research and development activity in this regard.

There are some important considerations and realities that must be dealt with in the design of a direct injection system. First, the nature of the pesticide must be considered, i.e., the formulation, whether a liquid concentrate, a flowable, a wettable powder or something else. At the present time, the known systems are being designed to handle only liquid formulations. The physical properties of viscosity and density must be known and especially how the viscosity may change with a change in temperature, if the metering is to be done accurately over the range of temperatures normally encountered in field operations. The concentration or strength of the product must also be known, as a value for this parameter will be needed to determine the metering rate of the pesticide concentrate into the system.

Early on in a design, the decision will need to be made whether the equipment will be product specific or will be designed to handle one or more pesticide formulations having different physical properties.

Although the same basic concept may be applicable to either ground-based equipment or equipment for aircraft, there are several aspects of aircraft systems that require special consideration. For example, larger flow and pumping rates are required as well as special fast acting control valves, because of the greater speed of travel. Weight, space and drag limitations, provision for shock and vibration mounting of components, among others, are factors that must be considered for aircraft systems.

Direct injection systems designed for use by private applicators, that is, farmers, may not satisfy the needs of commercial applicators, who may need to apply more than one compound at a time and who require equipment, because of a large amount of use, that features a high level of durability and reliability.

Proper tank sizing is not only important from the space and weight involved, but also the tank sizes need to be matched from a relative capacity standpoint so that both tanks will be empty at about the same time and one does not have to make two trips to fill one tank or the other. Provision must also be made for emptying and cleaning the concentrate tanks and system when it is necessary to use different materials, as well as disposing of the small amount of waste that may be generated in this process.

Since the metering device is the heart of a system, it must be selected to match the flow rates that it will be expected to handle and to provide the precision required. Means of adjusting the flow rate accurately and easily will need to be considered. If the pesticide concentrate metering rate is in response to ground travel, changes in ground travel speed will cause concentration transients that are a function of the system configuration and these will have to be carefully evaluated and minimized. The injection and mixing unit should be as close to the nozzles or discharge points as possible to minimize the amount of mixture in the supply lines and boom and minimize any undesirable concentration transient variations. However, this may result in relatively more of the concentrate material remaining in the concentrate supply lines. This may be satisfactory for single material systems, but must be considered if it is desired to have a system that will handle several different materials for long and reliable service.

The control system is where the newest technology will come into play, that is, microprocessor control technology. Microprocessors are currently used to monitor spray systems and perform specific application calculations. Thus, there is very little reason today that direct injection systems can not be monitored and controlled using such devices. In addition to monitoring and controlling, a microprocessor system could also be used to record pertinent operational information such as the type, amount and rate of pesticides used, weather data during application, dates and times of spray operations, field identification and location (including graphs showing salient features of the field and surrounding area) along with the application history for the field, among other things. Periodically, then, the recorded data would be removed and transferred to a master computer for permanent storage and analysis and reference.

Some important decisions have to be made relative to the attachment, detachment and filling of the concentrate containers, as well as what to do with the small amount of liquid that may be trapped in the connecting supply lines. There may well need to be closer cooperation between the chemical manufacturers, the container suppliers and the equipment manufacturers to solve some of these problems.

Simple and accurate calibration procedures will be needed to assure that the pesticide and diluent are being applied at the correct rates. Monitoring systems and displays will be required to assure proper functioning of the system. With the development of more concentrated and more costly pesticides, small mistakes in the application can not be tolerated.

Potential users of direct injection technology include production agriculture (field crops and orchards), wide-area control, vector control, right-of-way, lawn and garden, pest control (residential and business), nurseries, greenhouses, animal pest control and forestry. Several of these application industries are already using equipment featuring concepts of direct injection and others are using undiluted materials directly without further dilution. Thus it should be obvious that one machine or one system will not be suitable for all application needs. Different chemicals and formulations with different physical properties and different application rates and different required methods of application, will require different systems.

The matter of retro-fitting needs to be mentioned since not all of the work going on will lead to entirely new pieces of equipment. There are a lot of sprayers currently being used that will not and can not be thrown away. Thus, there is a built-in market for retro-fit equipment. However, considerable ingenuity will be required in order to design workable retrofit systems for the host of different types of ground and aircraft sprayer systems now in use.

The development of direct injection equipment is complicated by one other factor. The equipment industry serving the pesticide manufacturing industry is composed of a number of relatively small companies, small compared to the major pesticide manufacturers. Most of these companies manufacture a limited variety of rather specific equipment for a limited market -- and certainly a depressed market at this time. Few, if any, of these equipment companies have large amounts of money to invest in research and development for new and innovative products and thus will likely not venture very far away, very quickly, from traditional designs now in the market place. Along with some new products from these companies, it is likely to expect a number of new small companies to appear with new designs and products that address this new need. Because there is a demonstrated need for a new generation of products and because there is a new technology, that is, the microprocessor technology, available to control and monitor these more complicated systems, an increasing number of new and innovative designs are almost certain to be developed and marketed. Further, the designs of the equipment now in common use have essentially "matured" -- that is, there is not much more that can be done with them, as such, to improve their performance, especially given a new set of constraints placed on the process of application. Hopefully, the new designs and equipment that do appear in the market place will be carefully and thoughtfully designed and thoroughly field tested.

Pesticides are becoming increasingly sophisticated -- and will likely be more concentrated and accordingly, more expensive. Thus, the pesticide application equipment of the future, direct injection or whatever, will also have to be more sophisticated to accurately meter and precisely apply these materials at the prescribed rates in a safe and efficacious manner.

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WASTE WATER RECYCLING

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ABSTRACT

The Louisiana Department of Agriculture began enforcement of pesticide waste disposal regulations on January 1, 1985. These regulations pertain to all commercial pesticide applicators. Basically, these regulations require that applicators have facilities to clean the equipment spray tank, spray system, mixing tanks and pesticide containers without contaminating the soil, ground water or other bodies of water.

After evaluation of various pesticide waste disposal techniques, 60% of Louisiana's 190 commercial aerial applicators elected to use waste water recycling to dispose of aircraft spray system wash water.

Waste water recycling involves collecting the aircraft wash water and storing the water in tanks for use as a dilution agent on future application jobs. Three to five tanks are normally used to store various pesticides thus preventing label violations and the possibility of crop damage. Thirty percent of the applicators rinsed the aircraft over the field being treated. Ten percent modified the aircraft or used other waste disposal techniques.

At the completion of the 1985 season, several aerial applicators were interviewed to determine the cost of constructing and operating the waste water recycling systems as well as suggested operating procedures and problems encountered during 1985.

Most aerial applicators used a 50' X 50' or 50' X 60' cement wash area and three to five 250 to 500 gallon waste water storage tanks. Most waste water recycling systems cost $8,000 to $12,000 to build with a range of $3,000 to $15,000. Very few problems were reported and there were no reported incidences of crop damage.

INTRODUCTION

During 1981 and 1982, discussions were held between Louisiana aerial applicators, members of the Louisiana Cooperative Extension Service (LCES) and the Louisiana Department of Agriculture. These discussions covered techniques required to comply with proposed Louisiana Department of Agriculture pesticide waste disposal regulations (1), (2), (3).

It was generally agreed that pesticide containers could be converted from pesticide waste to solid waste via the well established triple rinsing process (4). Most of the pesticides commonly used in Louisiana require dilution with water prior to application. The water used to wash the containers could be easily used for dilution (4). Mixing and loading equipment could be easily washed and the wash water used for dilution. The triple rinsed containers could be sold for scrap or sent to an approved solid waste land fill for disposal. Based on EPA regulations, containment of water used to wash the exterior of the aircraft was not required (5). However, water used to wash the interior of the aircraft spray system must be contained and disposed of in an environmentally safe manner.

Current research, state of the art technology, public attitudes toward waste, cost of transporting and disposal of waste by hazardous water disposal firms as well as other factors were carefully evaluated. It was decided that an affordable, environmentally safe system must consider the following factors (1), (2), (3), (6):

1. The commercial aerial applicators, whether they have 1, 2, 3 or more aircraft, must be able to install the waste disposal facilities and provide quality aerial application at an affordable price. In short, the system must be affordable.

2. The applicator, pilots and/or loading crew members must be able to operate the system with minimal training.

3. The system must be compatable with normal operations and not require a lot of additional labor.

4. The system must be designed to eliminate the storage of waste at the applicators place of business during the off season.

5. The system must dispose of the pesticide waste without requiring transport of waste to hazardous waste disposal sites. It was generally felt that the industry could not afford this disposal technique.

After further research in 1982, it was decided that some type of waste water recycling system, rinsing the aircraft over the treated field or modifying the aircraft to clean the aircraft while in flight would meet these five objectives. Based on these conclusions, it was felt that rinsing over the field would be feasible for aerial applicators who flew less than 300 hours per year. However, it would be too costly for larger aerial applicators. Therefore, it was decided to further evaluate waste water recycling (2).

Engineers from the LCES designed a waste water recycling system to accomodate applicators with two or more aircraft. These systems were evaluated on a limited scale in 1982 and 1983 (7). Regulations adopted in 1984 by the Louisiana Department of Agriculture legalized the use of these systems (1), (4). Enforcement of these regulations began on January 1, 1985.

During 1985, about 60% of Louisiana's commercial aerial applicators built and used waste water recycling systems, 30% rinsed the aircraft over the treated field and 10% modified the aircraft or used other techniques (3).

AIRCRAFT MODIFICATIONS

Agricultural aircraft are equipped with 150 to 600 gallon spray tanks. After the completion of a spray job, 6 to 10 gallons of field strength pesticide will be left in the spray system. Three to five gallons of this pesticide will be in the bottom of the spray tank and three to five gallons will remain in the spray pump, spray booms and connecting lines. In addition, pesticide residue will remain on the inside walls of the aircraft spray tank (9).

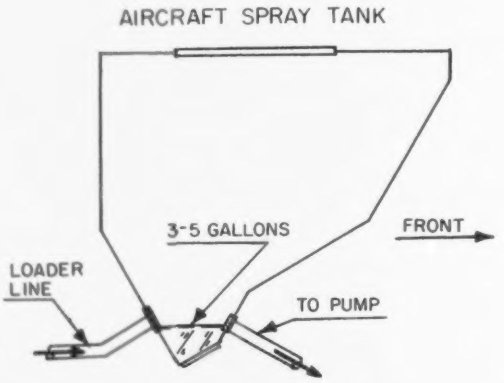


Figure 1. Aircraft spray tank illustrating location of various components and remaining 3 to 5 gallons of pesticide.

As shown in Figure 2, a simple device can be added to the pump intake to remove 2 to 4 gallons of pesticide. This pump intake extension is now commercially availible at a cost of $200 to $300 (9). This simple device will reduce pesticide waste by 30 to 40%. In addition, installing a simple check valve in the loader line will eliminate contamination of this area.

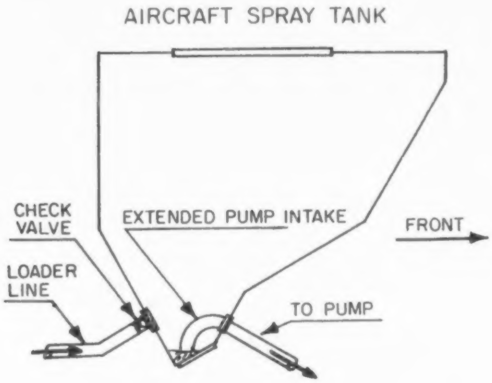


Figure 2. Aircraft spray tank illustrating installation of pump intake extension and loader line check valve.

WASH WATER RECYCLING SYSTEM

The wash water recycling system designed by the LCES consists of a cement wash area, a sump to contain the wash water, pump, connecting lines and 3 to 5 holding tanks with a capacity of 250 to 500 gallons each (7).

The size of the wash area constructed by Louisiana aerial applicators varied from 50' X 50' to 50' X 60'. Cost varied from $1.50 to $2.50 per square foot depending on the site preparation required, fill material required, thickness of cement, amount of steel used for reinforcement and other factors. As expected, applicators who did most or all of their own construction had the lowest cost (9). Specifications for the wash area, sump and tanks are contained in the Louisiana Department of Agriculture pesticide waste disposal regulations (4), (7).

The number and size of tanks depends on the size of the operation and the variety of pesticides used. Under Louisiana conditions most applicators will have three to five tanks with a capacity of 250 to 500 gallons each. The pesticide wash water must be segregated and stored in separate tanks to avoid label violations and the possibility of crop damage.

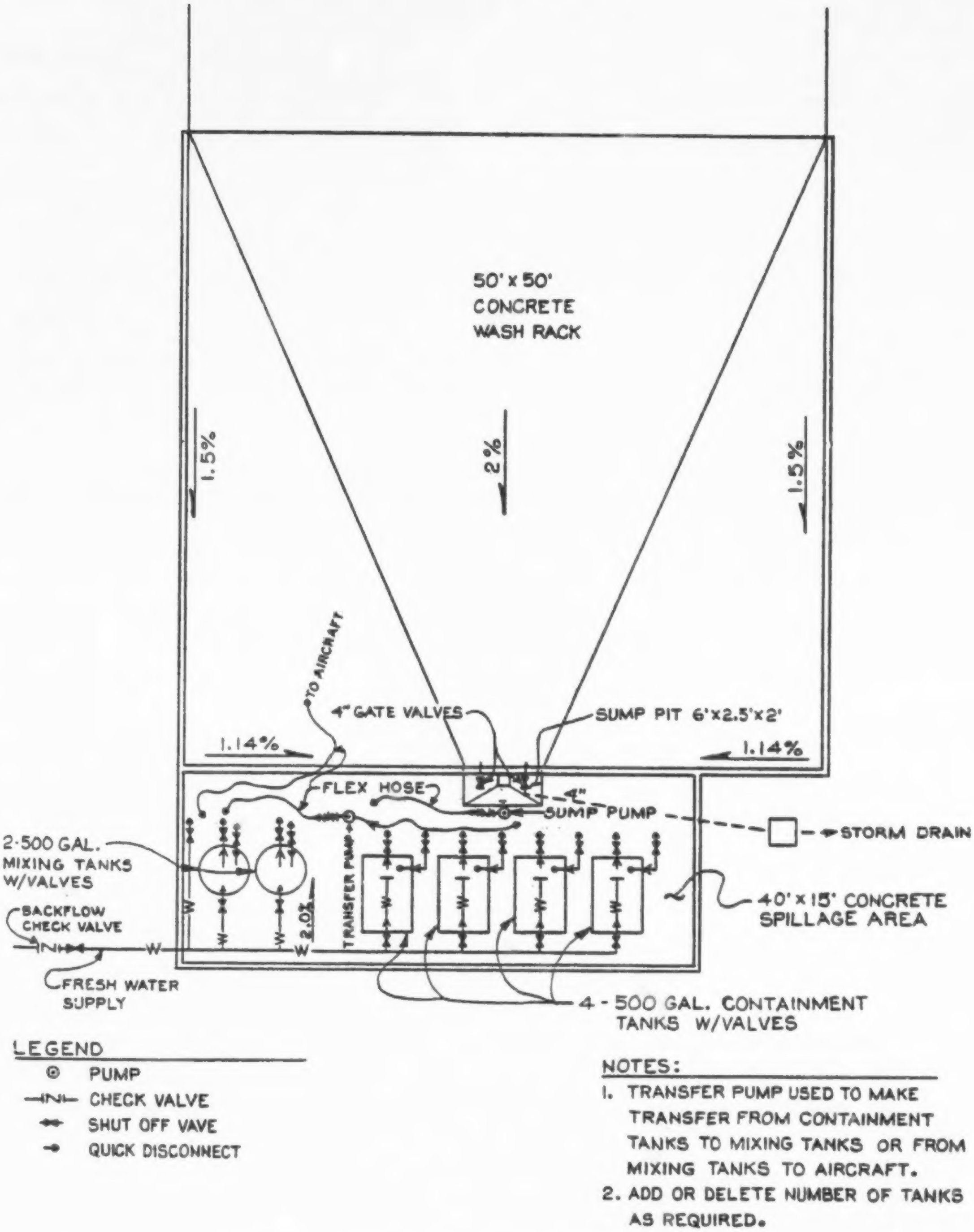
Tank cost varied from $50 to $550 per tank depending on tank size, type of tank, and whether new or used. A typical wash water recycling system is shown in Figure 3. Data for construction cost is shown in Table 1 and data for operating cost is shown in Table 2. This data is based on a system for 3 to 5 aircraft with each aircraft flying 400 to 700 hours per year.

TABLE 1. CONSTRUCTION COST FOR WASH WATER RECYCLING SYSTEMS

50' X 60' Cement Wash Area	$ 6,000
Five Tanks (500 Gallons Each)	2,750
Plumbing and Electrical	1,000
Pump (2 HP, 2" Capacity)	750
Labor	1,250
Total	$ 11,750
Range $3,000 - $15,000	

TABLE 2. ANNUAL OPERATING COST FOR WASH WATER RECYCLING SYSTEMS

Depreciation (10 year life)	$ 1,175
Interest on Investment (12% Interest)	705
Maintenance	500
Labor (75 Hours @ $6.00)	450
Total	$ 2,830



NOTES:

1. TRANSFER PUMP USED TO MAKE TRANSFER FROM CONTAINMENT TANKS TO MIXING TANKS OR FROM MIXING TANKS TO AIRCRAFT.
2. ADD OR DELETE NUMBER OF TANKS AS REQUIRED.

Figure 3. Typical Wash Water Recycling System

It is important to note that the cement wash area can be used to mix and load pesticides as well as service the aircraft. These costs are listed as a cost of pesticide waste disposal. In reality, a portion of these cost should be attributed to other phases of the operation.

Regardless of the waste water disposal system utilized, the waste water must first be collected. Facilities to collect the wash water is a major portion of the recycling system cost.

OPERATING PROCEDURES

The applicator must first decide what pesticide waste will be stored in each tank. It is important that wash water from various pesticides be segregated to avoid label violations and compatability problems. The applicator must label each containment tank so that all pilots and loading crew members will always know what waste is stored in each tank. This will reduce the possibility of errors in utilizing the wash water as a dilution agent in future application jobs. An example of how the tanks can be utilized is shown in Table 3. The type waste stored in the various tanks will vary from area to area within Louisiana as well as from year to year.

TABLE 3. EXAMPLE OF WASTE WATER CONTAINMENT TANK UTILIZATION

TANK NUMBER AND SIZE	TYPE OF WASTE WATER EARLY SEASON	LATE SEASON
1 (250 Gal.)	Soybean Pre-emerge Herbicides	Soybean Insecticides
2 (400 Gal.)	Soybean Post-emerge Herbicides	Soybean Defoliants
3 (500 Gal.)	Cotton Pre-emerge Herbicides	Cotton Insecticides
4 (500 Gal.)	Cotton Post Emerge Herbicides	Cotton Defoliants
5 (300 Gal.)	Rice Herbicides	Rice Insecticides

Note: The number and size of tanks can be varied to meet the needs of the applicator.

In this example, the wash water generated from clearing the aircraft after applying soybean pre-emerge herbicides will be stored in tank number one. Most soybean pre-emerge herbicides will be applied in April - June. Therefore, this tank can be cleaned and utilized to store soybean insecticide wash water during July - September.

Waste water from soybean insecticides will be recycled by mixing one part waste water with four parts fresh water for dilution of the soybean insecticide.

The second step in utilizing the waste water recycling system requires that the applicator decide whether or not to wash the aircraft between spray jobs. As an example, when changing from soybean fungicides to soybean post-emerge herbicides to soybean insecticides it will not be necessary to wash the aircraft. All three types of pesticides are labeled for application on soybeans. Therefore, phytotoxicity and label violations will not be a problem.

The applicator should use his experience, judgement and knowledge of various pesticides to schedule application jobs and aircraft washing to minimize the volume of wash water.

The applicator should never store wash water unless he knows of a future job where this wash water can be added to the pesticide mixture and promptly applied. Ideally, waste water should be used within two weeks.

The aircraft should be rinsed over the field being treated if the applicator is uncertain about how or when he can recycle the wash water. This is especially true if the pesticide is seldom used in his operation.

Rinsing the aircraft over the treated field could be costly and time consuming. However, this could be less costly than transporting the waste to an approved disposal site or other types of on-site treatment.

The applicator can use two techniques to collect the aircraft spray system wash water. The first technique involves dumping the waste on the cement wash area. The second technique allows pumping the pesticide waste and wash water directly from the aircraft.

If the first technique is used, the wash area should be washed to remove all soil particles and other debris. The aircraft is then taxied onto the cement wash area. After dumping the waste pesticide, the aircraft spray system is thoroughly washed. This includes washing the spray tank and purging the spray booms, spray pump and all connecting lines.

The waste pesticide, spray system wash water and water used to again wash the cement area is drained into a sump located adjacent to the wash area.

The waste pesticide and wash water is pumped into the storage tank designated for storage of this type waste water.

The second technique requires connecting hoses with appropriate adaptors to the outer end of each spray boom. The spray system is washed as previously described. The waste pesticide and wash water is pumped into the designated storage tank. The pump will promptly remove all waste from the spray boom. Thus, very little, if any waste will drip from the spray nozzles.

Use of this system reduces contamination problems that could cause aircraft nozzle plugging.

The use of flexible hoses to transfer the wash water from the aircraft to the containment tanks is recommended. After cleaning the aircraft, the hose is always flushed with clean water to remove all pesticide residue. This practice eliminates cross contamination and possible label violations as well as crop damage. In addition, physicially connecting the hose to the proper storage tank assures that the wash water will be stored in the proper tank. This practice also holds true when removing the water from the tanks.

Applicators report that it requires at least 60 to 80 gallons of water to thoroughly wash the aircraft spray system (9). The aircraft spray system will normally contain 4 to 7 gallons of field strength pesticide waste. Therefore, the waste water stored in the containment tanks will have a pesticide concentration of less than 10% of normal field strength (9).

One part wash water should be mixed with four parts fresh water when using the water for pesticide dilution. The resulting spray mixture will contain a maximum of 2% additional pesticide. This low level of additional pesticides reduces the possibility of label violations, illegal residue or crop damage should an error be made in mixing.

SUMMARY

Interviews with Louisiana aerial applicators after the completion of the 1985 spray season indicates that problems were minimal. Pesticide waste can be disposed of by rinsing the aircraft over the treated field or recycling the wash water. There were no reports of illegal crop residues or crop damage caused by recycling of pesticide wash water.

Aerial applicators flying less than 300 hours per year felt that rinsing the aircraft over the field costs less than constructing waste water recycling systems. Larger applicators felt that use of a recycling system consisting of three to five 250 to 500 gallon tanks and a 50' X 50' to 50' X 60' wash area was a good investment. Construction cost ranged from $3,000 - $15,000 with most systems costing $8,000 - $12,000. Annual operating cost was about $2,500 - $3,000 for an applicator with 3 to 7 aircraft with each aircraft flying 400 to 700 hours per year.

Most applicators reported that the large cement wash area was ideal for mixing and loading pesticides as well as servicing the aircraft. Also, when evaluating the cost of any pesticide waste disposal system, the cost of the collection facilities must be included.

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RECYCLING PESTICIDE RINSEWATER

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ABSTRACT

Rinsewater recycling is proposed as an alternative to the treatment or disposal of potentially large quantities of pesticide laden washwaters. A recent Illinois study shows that economical management systems can be installed by custom applicators using ground equipment for collecting and subsequently re-using dilute pesticide solutions. The recycling process is most feasible in the Midwest where applicators treat primarily corn and soybean acreages and should be applicable to other areas where applicators apply pesticides to a limited number of crops. Practicality of the process diminishes as the variety of crops grown increases or when incompatibility of pesticides or adverse effects may result. Presented in this report are design and management recommendations for pesticide rinsewater recycling systems derived from the Illinois project.

INTRODUCTION

Improper pesticide rinsewater management practices have become an increasing environmental concern for regulatory officials and custom applicators in Illinois. State and federal regulations discourage and in some cases prohibit the disposal of pesticide rinsewaters by landfilling. Treatment systems including evaporation basins, trickling filters, and sedimentation/carbon adsorption apparatuses have been designed but infrequently implemented by the industry because standards that define limitations and acceptability for use have not been established.

During the 1984 spray season Growmark, Inc., engineers and Illinois EPA staff initiated a project to study the feasibility of recycling pesticide rinsewaters by using them as a diluent in corn and soybean herbicide spray solutions. Management systems at thirteen commercial agrichemical facilities were examined.

SYSTEM COMPONENTS

The two basic components of the rinsewater management systems observed are a concrete wash pad and receptacle for rinsewater containment. The wash pad design varies at each installation to conform with the physical layout of the site and to accommodate loading devices and spray equipment used. Concrete tanks serve as the means of containment. The following design criteria include the preferred features noted at the study sites.

Wash Pad Design

The wash pad is typically 20- by 40-feet (ft.) concrete slab. It is instrumental to the operation of the rinsewater containment systems as it catches water generated in the washing of spray equipment, drippings from hoses, and foamovers that occur while loading.

To insure structural integrity, the concrete is 8 inches (in.) thick and reinforced in two layers with #10 wire mesh in the upper half and #4 reinforcement rods crossed on 16 in. centers 2 in. up from the bottom. The pad is constructed with a 2% slope to a center drain situated in a recessed mud pit which is used for trapping sediment and other debris (Fig. 1). Dimensions of the mud pit are 2 ft. x 4 ft. x 2 ft. deep. A middle partition provides separate drainage for corn and soybean chemicals. The pit cover is a welded steel grate that is underlain by a sliding steel plate to facilitate chemical segregation (Fig. 2).

Rinsewater Containment

The most efficient device for collecting rinsewater draining from the wash pad is a 1,000 gallon (gal.) concrete tank. A pre-cast tank or a poured tank made of high density 6,000 psi concrete can be used for this purpose.

The collection tank is preferably set off to the side of the wash pad; however, if space is limited the tank can be situated beneath the pad (Fig. 3). In either case, a manway into the tank must be provided for periodic inspection and cleaning. In setting the tanks, sand or compact backfill must be used to prevent settling.

A resistant sealant applied to the joints and surfaces of the tanks prohibits seepage. For the poured tanks a waterstop is incorporated into all joints to further insure containment.

Plumbing from the wash pad to the tanks consists of schedule 80 black iron pipe 3 in. in diameter or larger.

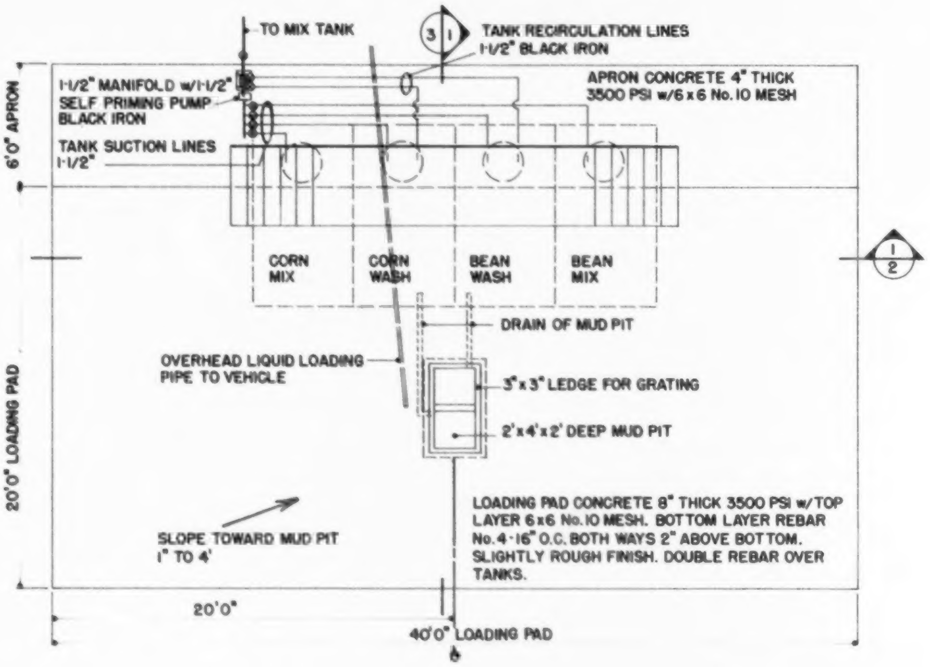
TO MIX TANK
3
1
TANK RECIRCULATION LINES
1-1/2" BLACK IRON
APRON CONCRETE 4" THICK
3500 PSI w/6 x 6 No. 10 MESH
1-1/2" MANIFOLD w/1-1/2"
SELF PRIMING PUMP
BLACK IRON
TANK SUCTION LINES
1-1/2"
6'0" APRON
CORN MIX
CORN WASH
BEAN WASH
BEAN MIX
1
2
DRAIN OF MUD PIT
OVERHEAD LIQUID LOADING PIPE TO VEHICLE
3" x 3" LEDGE FOR GRATING
2' x 4' x 2' DEEP MUD PIT
20'0" LOADING PAD
LOADING PAD CONCRETE 8" THICK 3500 PSI w/TOP LAYER 6x6 No.10 MESH. BOTTOM LAYER REBAR No.4-16" O.C. BOTH WAYS 2" ABOVE BOTTOM. SLIGHTLY ROUGH FINISH. DOUBLE REBAR OVER TANKS.
SLOPE TOWARD MUD PIT
1" TO 4'
20'0"
40'0" LOADING PAD

Figure 1. Top View Diagram of a Pesticide Rinsewater Collection System

The collection tank set up varies depending upon the scope of the operation. A minimum of two tanks is required in order to segregate corn and bean chemical rinsate. The plumbing is systematized to accommodate this arrangement. Additional tanks can be added to hold haulback solution. The haulback tanks do not need to be plumbed through the wash pad drainage system since the unused spray solution can be drained directly from the applicator into the tanks. Where porous soils and high groundwater conditions exist, storage of the rinsewater and haulback in above ground tanks should be considered if not already required by state or local regulations. In any case the underground tanks should not be used as a permanent storage facility.

Used steel petroleum tanks have also been used as the underground containment vessel. There are two inherent problems with this alternative. First, a substantial volume of liquid must remain

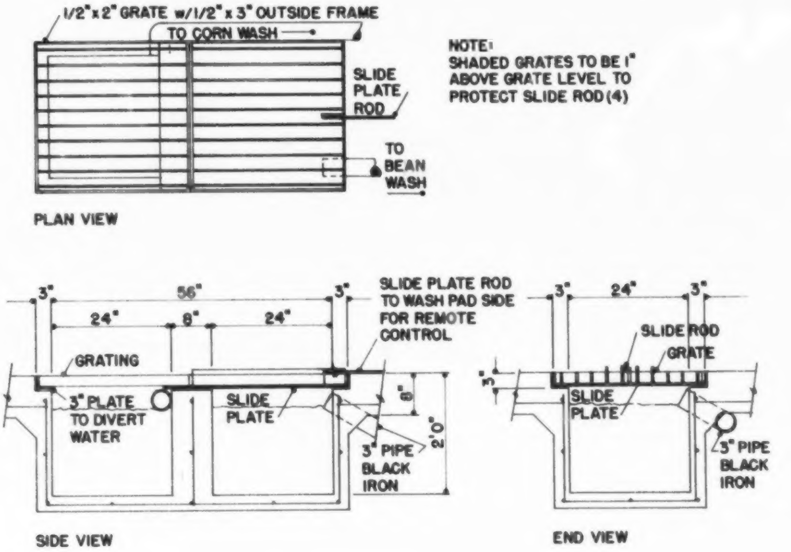

Figure 2. Mud Pit Configuration for a Pesticide Rinsewater Recycling System.

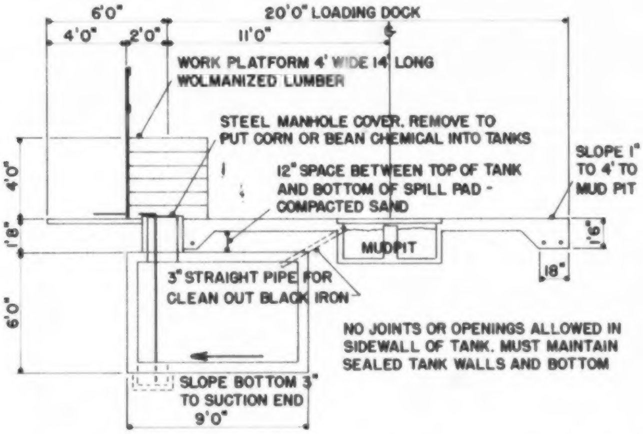
6'0"
4'0"
2'0"
20'0" LOADING DOCK
11'0"
WORK PLATFORM 4' WIDE 14' LONG WOLMANIZED LUMBER
STEEL MANHOLE COVER. REMOVE TO PUT CORN OR BEAN CHEMICAL INTO TANKS
12" SPACE BETWEEN TOP OF TANK AND BOTTOM OF SPILL PAD - COMPACTED SAND
SLOPE 1" TO 4' TO MUD PIT
4'0"
1'8"
1'6"
MUD PIT
18"
6'0"
3" STRAIGHT PIPE FOR CLEAN OUT BLACK IRON
NO JOINTS OR OPENINGS ALLOWED IN SIDEWALL OF TANK. MUST MAINTAIN SEALED TANK WALLS AND BOTTOM
SLOPE BOTTOM 3" TO SUCTION END
9'0"

Figure 3. Side View Diagram of a Pesticide Rinsewater Recycling System.

in inadequately anchored tanks during the off-season because the containers, when empty, will have a tendency to float out of position under saturated soil conditions. Of greater concern is the corrosive property of the steel which may effect leakage resulting in groundwater contamination.

A third containment alternative is an industrial-type lagoon. However, these surface impoundments are particularly susceptible to overflow in humid climate regions, a threat to groundwater when not properly sealed, and in most situations require groundwater monitoring wells. Considering these factors, lagoon systems are not recommended.

Clean Water Diversion

The wash pad/loadout facility should be situated so that it is elevated above the surrounding area to prevent stormwater from overloading the collection system. Where this is not feasible, curbing or earthen diversions can be employed.

If provisions are made during the initial construction, the loading pad could eventually be covered with a roof or building, thus eliminating rainwater falling onto the pad.

An alternate set up could incorporate two drains to allow separate drainage of contaminated rinsewater from ordinary rainwater when the system is not in use. Each drain should have a plug which seals tightly yet is easily and quickly removed.

Cost of Construction

Cost estimates for the basic unit which includes the wash pad, four tanks, plumbing and pumps are itemized in Table 1. Variation from region to region can be expected for the cost of materials and labor. As extras are added such as roofs or enclosures, the expenses of construction will escalate.

TABLE 1. INSTALLATION COST ESTIMATES

Wash pad		$2,500
Tanks (4) - pumps plumbing, etc.		$5,500
Labor		$2,800
	Total	$10,800

PESTICIDE RINSEWATER RECYCLING

Water samples were collected from the containment facilities at the thirteen agrichemical outlets throughout the spray season and were analyzed for the pesticides introduced into each respective system. Concentrations in the rinsewater mixtures were compared to those in standard spray solutions to assess potential contamination problems and to determine dilution factors for reuse.

Analyses Comparisons

Table 2 compares active ingredient concentrations of rinsewater solutions taken from the concrete tanks at four different locations during the

TABLE 2. RINSEWATER ANALYSES FROM FOUR CONTAINMENT FACILITIES

Active Ingredient	Sample Source Site A	 Site B	 Site C	 Site D
		(ppm)		
Atrazine	270	84	1100	120
Cyanazine	---	310	9	39
Metalochlor	540	65	34	---
Alachlor	390	180	160	600
Metribuzin	---	44	6	220
Trifluralin	170	40	6	130
Butylate	310	11	1	---
Total	1,680	734	1316	1109

mid-season. The analyses show variability among the individual components which is attributed to the fraction of corn and soybean acreage being treated and the preference for certain products in each respective region. The range in total active ingredient concentrations is representative of all the sites sampled.

Effect on Spray Solutions

Herbicide spray solutions for corn and soybean production in Illinois are typically blended for application with a ground spray unit at a rate of 20 gal. per acre. Since water is the most common carrier, there is considerable interest in recycling rinsewater as a part of the spray mixture, thus avoiding the need to treat or dispose of large volumes of dilute pesticide solutions. Table 3 illustrates the effect of using the most concentrated rinse solution analyzed in the study as a 5 percent component of some commonly used herbicide spray solutions.

The study concluded that the addition of rinsewater at a 5 percent rate will very slightly influence the total active ingredient concentrations of the spray solutions. In each case the total falls well within the limits allowed for the primary active ingredient when used alone, which tends to support the reuse concept.

Precautions for Reuse

Blending of the rinsewater into the spray solutions does raise some questions, particularly for regions where more diverse and sensitive specialty crops are grown. Although USEPA's policy allows the tank mixing of different pesticides, unless it is specifically prohibited on the product label, there is concern about the reuse of rinsewaters having varying levels of pesticide constituents since trace amounts of some pesticides could be phytotoxic to the crop when applied to non-labeled target areas and the potential exists for residues in excess of established tolerances.

Insuring against the potential phytoxicity and residue problems is most feasible where the recycling of rinsewater is limited to corn and soybean acreage. A favorable point is that a number of the pesticides commonly applied are registered for use on both crops, which reduces the probability of the rinsewater causing adverse effects. To further provide a margin of safety, segregating of corn chemical rinsate from bean chemical rinsate is highly recommended. Chemical segregation is readily accomplished via the design of the rinsewater collection system. The practicality of doing this, however, decreases as the variety of crops being treated by the applicator increases.

TABLE 3. RINSEWATER EFFECTS ON SPRAY SOLUTION CONCENTRATIONS

Herbicide	Average Rate Per Acre	Standard Spray Solution Concentration[a]	Allowable Rate Variation[b]		Recycle Variation with 5% Rinsewater
		(ppm)	(+/-ppm)	(+/-%)	(%)
Atrazine	4.75pt	14,100	1,500	10	.60
Cyanazine	2.50qt	15,000	3,000	20	.56
Metalochlor	2.00pt	12,000	1,500	12	.70
Alachlor	2.75qt	16,300	3,000	18	.52
Metribuzin	.87pt	2,600	375	14	3.23
Linuron	.62pt	1,870	375	20	4.49
Pendimethalin	2.50pt	7,500	1,500	20	1.12
Butylate	4.25pt	21,300	2,300	11	.39
Trifluralin	1.50pt	4,500	750	17	1.87

[a] Based on median recommended application rates applied with water at 20 gallons per acre

[b] Based on manufacturers' label recommendations for medium textured soils

Herbicides that are foliar applied have less opportunity for exposure to attenuating factors prior to plant uptake than those applied to the soil. However, without extensive testing it is not possible to compare the differences in effects of recycling rinsewater in preplant or preemergence soil applied sprays versus postemergence foliar applied sprays.

The University of Illinois conducted a pilot study in 1985 using different amounts of a rinsewater solution that was made up of a blend of thirteen corn and soybean herbicides in postemergence herbicide treatments on soybeans. As the concentrations of rinsewater in the spray solution increased from 5% to 25% the visible damage to the soybean plants increased. The lower concentrations produced necrotic spotting while higher concentrations resulted in leaf crinkling and cupping. In all cases, however, the plants appeared to recover before reaching maturity.

Since the soil environment in productive cropland areas is conducive to microbial degradation of most pesticide chemicals when applied at recommended labeled rates, and it possesses a limited capacity to buffer against adverse chemical effects via chemical reactions and adsorption, it is recommended that the reuse of rinsewater solutions be limited to preplant or preemergence soil applications to expose the pesticides to these soil related attenuating mechanisms, and that the rate of reuse be restricted to 5% of the spray mixture or less to preclude the possibility of over-applying chemicals to the extent of impeding the soil reactions.

Other Considerations

Since the wash pad is used for loading operations as well as rinsing equipment, there is a chance that spillage will occur. When a quantity of spilled concentrate is washed down into the collection tank it is important that the amount be recorded to enable the operator to calculate the approximate dilution needed to maintain the lower rinsewater concentrations. If this is not possible a chemical analysis may be required before the tank contents are used.

PLANNING CONSIDERATIONS

The implementation of a rinsewater recycling system necessitates a management scheme to budget the use of rinsewater generated. First the volume of rinsate produced seasonally is estimated and then the acreage required for utilization can be determined. The following scenerio describes a situation representative of an Illinois establishment that custom applies chemicals for corn and soybean production.

Scope of Operation

It is assumed that the spray season will extend through a twelve week period in the Spring with overlapping corn and soybean plantings. During that time two applicators will run an average of five days a week being shut down only by rain and wet field conditions.

Tank Rinsings

With two spray units operating full time it is possible to minimize the number of tank rinsings by using one applicator on soybean acreage and the other on corn at the time when both crops are being planted. However, during the middle six weeks of the season it is likely that scheduling conflicts will require that each unit be rinsed once a day on the average in order to switch chemical sprays. This equals a total of 60 tank rinsings. Approximately 50 gallons of water are used for each rinse resulting in 3000 gallons of rinsewater being generated.

Exterior Equipment Washings

Both weather conditions (i.e. a wet season effecting more mud) and maintenance priorities of the plant manager will dictate the number of times the spray rigs are washed, but for this purpose it is assumed that each applicator will be cleaned every other day of use. If a high-pressure nozzle is used and each unit is washed for fifteen minutes, the 60 washings at 90 gallons per event would produce 5,400 gallons of exterior washwater.

Wash Pad

The concrete pad used for loading and cleaning equipment should be rinsed off after each day's use. This calls for 60 washings utilizing 50 gallons each time for a seasonal total of 3,000 gallons.

Estimate Variations

This example indicates a typical Illinois facility could generate approximately 11,400 gallons of pesticide rinsate during the spray season. Factors that may effect the total are the number of operating spray rigs and the manager's maintenance priorities.

Increasing the number of applicators would require additional exterior washings if the equipment is to be cleaned on a regular basis. However, at the same time having more units to operate during the overlapping corn and soybean planting seasons could decrease the requirements for tank rinsing if each piece of equipment is used soley on one crop.

There is considerable difference among custom applicators as to their preference for maintaining clean equipment. Some elect to wash their units daily while others may only perform this duty several times a season. At a minimum for planning purposes, it is preferrable to assume the equipment will be rinsed off after two day's use.

Rainwater

Rinsewater collection facilities that are constructed without roofs or diversions will also have to contend with rainwater. Although this stormwater will not add to the chemical concentration in the system it will increase the volume of recycle water that the facility operator must manage. To estimate the increase in volume one must ascertain rainfall records for the respective area and calculate the amount that would potentially fall on and be collected by the rinse pad system.

Acreage Requirements

When spray solutions are mixed for applications at the rate of 20 gal. per acre and the amount of rinsewater used as the diluent equals 5% of the total volume, one acre of land is required for every gallon of rinsate that is recycled. The custom applicators at the thirteen study sites treat approximately 5,000 to 6,000 acres per spray unit that is in operation. This indicates that managing the rinsewater via recycling is feasible but must be done on a tightly planned schedule to prevent large volumes of rinse solutions being leftover at the end of the preemergence spraying season.

SUMMARY

Estimates show that a typical custom applicator in Illinois generates over 11,000 gallons of rinsewater containing various levels of pesticides during a spray season. Pesticide rinsewater recycling systems appear to be a practical and feasible means of managing these large volumes of dilute pesticide solutions.

The rinsewater recycling process does afford the potential for phytotoxic effects and crop residues to occur. Preventive measures that are employed to protect against such consequences include; 1. segregating rinsates of chemicals registered for different crops; 2. using rinsewater as a low percentage of the spray solution (5% by volume or less); 3. limiting rinsewater reuse to preplant or preemergence applications, and; 4. maintaining the dilute status of the solutions in the rinsewater containment tanks.

TANKS AND FITTINGS FOR FLUID FERTILIZERS, PESTICIDES AND OTHER LIQUID PRODUCTS RELATED TO AGRICULTURE

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ABSTRACT

There are many acceptable ways to store pesticides in bulk. The safest method is in a 316 stainless steel UL 142 approved tank. This tank meets fire codes. Also, there are 304 stainless steel, mild steel, mild steel coated, fiberglass and pololyfin tanks. All these tanks will contain the same types of pesticides. In order to have a good, safe system, it is important to know which tank material is compatible with the pesticide to be stored.

After the tank material has been decided, the valves and fittings should then be considered as to what is compatible with the product to be stored. Valves, more often than not, should be 316 stainless steel locking valves. The material of the nipple between the tank and the valves is very important. Never used PVC nipples. The results can be diasterous.

Venting of pesticide tanks is very important. The vent should be as large as the outlet of the tank and should have a vacuum pressure release.

The compatibility of plumbing and products when transfering the stored product is an absolute. Manufacturer's recommendation for product to be used in hoses should be closely followed. Never try to use the same hose and plumbing for different products. Hose pressure rating requirements should also be observed.

When pumps and meters ure used, they should be constructed of material compatible with the product. Meters should meet state requirements when used for resale purposes. Most states do not have rules regulating metered sales of pesticides, but to avoid problems, check local codes with the local weights and measures department.

All tanks should be diked. The dike should be made to hold the product for a reasonable time in case of a spill. In many areas an earthern dike will not work because of soil percolation. The most common dike is the concrete walls and floor. This seems to work very will with pesticides. Concrete however, has a problem with phosphoric acid. Be careful if both are stored in the same diked area. Poly dikes are new on the market. Check local codes before purchasing a poly dike and check product compatibility with the dike material.

Mini-bulk storage is very often misunderstood. This misunderstanding is from the lack of uniform regulations. The major manufacturers of pesticides have added to the confusion by setting up their own rules. These rules are often different form the E.P.A. and the state regulations. To protect yourself, know the rules.

For safe bulk storage - know your product, choose the best available equipment and know the rules.

When purchasing tanks and fittings for fluid fertilizer, pesticides and other liquid products related to the agricultural industry, it is important to be serviced by a knowledgeable and reputable firm. A firm which has years of experience and technical people familiar with tanks and fittings will know the requirements of the fertilizer industry and the regulatory bodies thereof. A tank user can ill afford a loss of inventory or a violation. First cost is not necessary the least. Spills detract from profits. Select a tank properly and inspect it regularly.

Six basic tank types are available for use in fluid fertilizer and pestidice storage.

1. Stainless steel, mild steel tanks
2. Fiberglass tanks
3. Polyolyfin tanks
4. Underground lined pits
5. Aluminum tanks
6. Used brewery tanks

Again, we state that is important that the sales person know excatly what products are to be stored in the tanks.

1. A. 316 stainless steel tanks are usually adequate for the storage of phosphoric acid and spent phosphoric acid and/or most other chemicals and pesticides common to the agricultural industry.

B. 304 stainless steel tanks are adequate for most purposes except phosphoric acids and some trace element solutions.

C. Mild steel tanks are economical and provide approximately 20 years of use for storage of fluid fertilizers. They are usually not considered adequate for phosphoric acid, some trace element solutions or pesticides.

D. Mild steel coated tanks may be coated with epoxy resins, enamel glass or many other compounds. These compounds usually extend the life and use of the mild steel tank. The advantages of coated tanks are the increased life and that many more products such as phosphoric acid, trace elements or pesticides may be stored in the tank. The linings are designed for specific products and if the product is to be changed, compatability of lining and product should be considered. In maintaining lined tanks, it is very important to repair and properly patch the inside of the tank when damaged occurs or if the coating develops a crack. If this is not done, the tank is again a plain mild steel tank thay may not have the capability of storing the products for a long period of time. All mild steel tanks, whether coated or uncoated should have 304 stainless steel threaded or flanged fittings welded into them. Mild steel tanks are welded and it is important that the proper metal is used in repair. If in doubt, use a high nickel contect rod and/or stainless steel to repair a mild steel unit.

A major problem associated with fluid fertilzer and pesticide storage tanks is the process called electrolytic action. This simply involves the static electricity in the air accumulating in the fertilizer solution and causing the metal of the least resistance to be transferred through the fertilzer solution to the top of the tank. For this reason, all welded fittings, repairs and valves should be of better quality material and least resistant to the electrolytic action than the tank body. Cast iron or mild steel fittings in these situations of fluid fertilizer storage will deteriorate and cause failure of the storage unit. If electrolysis exists, the tank should be grounded.

2. Fiberglass tanks are very specific for the products stored. There are two major kinds for the fertilizer industry. Those for the storage of phosphoric acid and those for the storage of nitrogen solutions and/or mixed fertilzers. They must be designed for the product. Those for phosphoric acid should have 316 stainless steel threaded fittings or flanges incorporated into the fiberglass and those for other fluid fertilizers may use 304 stainless steel threaded or flange fittings and bolts. It is estimated that their useful life will be approximately 20 years. They have not been on the market long enough to determine that his is an accurate estimate. Fiberglass tanks may be repaired with fiberglass and resin should be checked regularly for cracking. If the tank becomes weathered on the outside, it should be treated with resine to add to its life.

3. Polyolyfin tanks are of many and varied compounds. Their use should probably be limited to smaller units specifically engineered for individual products. Some of them are very susceptible to punctur and/or cracking. Most cracks, depending upon the location can be repaired. Their primary use should be for fluid fertilizers containing N P K and nitrogen solutions. If properly engineered, they do have the capability of storing many other products. Some are made with threaded

fittings molded into the compound and others have blank holes in them that are fitted with nylon threaded lock nuts and Viton O rings. It is very important when installing these that the O ring not be damaged and a perfect seal be established on the fittings. Some type of support should be used under the nipple and valve to prevent cracking. The length of life on these tanks are quite variable in that the compounds used are variable. The quality and amount of compound used is varied. Color affect the ultra violet decomposition of the compound. White tanks absorb more ultra violet rays and thus decompose the compound. Dark colors relfect and increase the life of the compound.

4. Plastic underground lined pits have resulted in an economical and simple storage capability during recent years. This involves using the earth shaped into the form of a pit or pond, lined with a nylon reinforced plastic liner and glued fittings. These structures usually have large volume capabilities holding 1,000 to 10,000 tons of fluid fertilizer or phosphoric acid. They are not recommended for pesticide storage. Again, they must be engineered for a specific use. They are usually set up with their own spill and/or leak preventing system and are safe if properly constructed.

5. Aluminum tanks are good for the use of nitrogen solutions and some pesticides. Steel fittings should never be used with aluminum tanks. A reaction will result between the two metals and possible product loss.

6. Used Brewery tanks and equipment are now being used in the fertilizer industry. The standard fittings on these tanks are brass, monel and plated brass. All of these fittings should be changed. If in doubt, contact a supplier of fittings and valves for advice as to what is needed for a brewery tank.

VALVES AND FITTINGS -

Fittings for fluid fertilizer and pesticide tanks are specific. There are many substitutes for Association recommendations but there are reasons for not using these products.

For phosphoric acid and some trace element solutions use only 316 stainless steel nipples, plugs, bushings and flanges. 316 stainless steel ball valves with Teflon seals should be used.

For pesticides, 304 stainless steel nipples, plugs, bushings and flanges are adequate. 304 or 316 stainless steel ball valves with Teflon or Viton seals should be used.

For other fluid fertilizers and nitrogen solutions of 32% or below, forged steel or 304 stainless steel plugs, bushings and flanges should be used. Nipples should be 304 stainless steel or better qaulity. Flanged or threaded ball valves may be used but rubber lined nickel cast valves with stainless steel butterflies are more economical and adequate.

All storage vessel valves should have a locking mechanism. Approximately 25% of "spills" are caused by vandals opening sight gauge or main valves during non-business hours.

Valves should be installed with flanges, clamps or unions so they can be removed from the storage unit for inspection and repair. Valve linings, seals, balls or butterflies may be damaged by debris in materials flowing through the valve. Remove and check all valves every two years or whenever they leak.

Polyropylene and plastic valves are prone to break in cold weather. Cast valves without rubber linings will disintergrate or corrode because of electrolysis. Some butterfly valves are made with O rings around the outside of the butterfly for a seal. These are too easy to damage in use and then leak. Follow the above recommendation for long service without loss of material. Dealing with a reputable supplier who knows your product specifications is a must.

DEALING WITH EMERGENCIES

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ABSTRACT

Discharges and releases of pesticides into the environment are almost daily occurrence throughout this country. Parties responsible for such spills and government agencies responding to such events must be prepared to handle a variety of situations. The key to successful response is adequate planning prior to response. This means the development in testing of a local or community contingency plan. This plan should project probable locations where emergencies may occur, and the chemicals most likely to be involved. The plan should address the spills from transportation related events and those occuring from fixed facilities. The local contingency plan should also address chemicals likely to be needed for neutralization or treatment of spill materials, where these materials can be obtained, how long will it take to deliver such materials to the scene of the emergency, and who will be responsible for obtaining and delivering such materials. The plan should also identify the local government agency responsible for responding to the emergency. In addition the plan should address how operations at the local level will interface with response operations identified in state, regional, and national contingency plans.

During the response phase of a pesticides emergency, the responding agency must be aware of its limitations. When these limitations are exceeded, the response agency must know how to obtain additional response information, and how to obtain response assistance from other governmental agencies or private sector groups. The capabilities of such agencies or groups should be known to the local response agency. Methods for contacting these agencies or groups on a twenty-four hour per day basis must also be known to the local response agency.

The discharge or release of a pesticide into the environment frequently invokes the jurisdiction of State and Federal laws and regulations. Some of these Federal laws include the Federal Insecticide, Fungicide and Rodenticide Act; the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; the Clean Water Act; and the Clean Air Act. Responding parties must be aware of these regulations or know how to contact Agency personnel who can provide appropriate information. These regulations typically deal with notification, clean-up liabilty, and treatment and/or disposal requirements.

INTRODUCTION

Discharges and releases of pesticides into the environment are almost daily occurrences throughout this country. More than one-third of the 379 chemicals recently identified by the Environmental Protection Agency (EPA) as acutely toxic chemicals are either pesticides or active or inert ingredients of pesticides. Pesticides may enter the human body through three routes: dermal, oral ingestion, and respiratory exposure. Therefore, it is essential that these emergency situations involving pesticides be dealt with in a proper manner. Dealing with these emergencies involves proper contingency planning, adequate response, and recognition of legal considerations.

CONTINGENCY PLANNING

The key to successful response is adequate prior planning. Contingency plans are needed at the National, Regional, State and Local government levels. The EPA has published the National Contingency Plan (40 CFR Part 300) and the EPA Regional Offices, in cooperation with the Regional Response Teams, have published regional contingency plans. State agencies have also developed and published various contingency plans. However, the most critical and important contingency plan is the community plan or the facility plan. Facility plans could be made a subpart of the community plan or be coordinated with and referenced in the community plan.

In 1981 the Federal Emergency Management Agency (FEMA) published guidance for developing such plans. This guidance entitled "Planning Guide and Checklist for Hazardous Materials Contingency Plans" (popularly known as FEMA-10) can be obtained from the FEMA Regional Offices. It is currently undergoing revision by the FEMA and the EPA. Another useful document is the "Chemical Emergency Preparedness Program Interim Guidance" published in November 1985 by the EPA. This document is part of EPA's Chemical Emergency Preparedness Program (CEPP). CEPP is part of the Agency's strategy to address accidental releases of acutely toxic chemicals. The goal of the CEPP is to assure that communities are prepared to deal effectively with possible accidental releases of acutely toxic chemicals. Developing community awareness and contingency planning are essential parts of the process of becoming prepared. This is not a new goal - only a renewed emphasis on improving preparedness nation-wide, which EPA has been working to achieve during the last decade.

Both contingency planning guidance documents provide outlines of suggested contingency plans. Since these documents provide detailed information, I will only highlight some elements of a plan that I feel are particularly important. My comments are mostly directed toward preparation of a facility plan.

Inventory

One of the first steps in developing a facility plan is to prepare an inventory of the pesticides at the facility. The inventory should identify the chemicals that are acutely toxic, flammable, explosive, or reactive. The updated inventory should be kept at the facility and the local fire department or the local response agency. It will dictate many elements of the contingency plan. The inventory should also describe the location of various types of pesticides and other chemicals. Physical separation of the types of chemicals at the facility will aide in efficient emergency response. Chemicals also should be separated from work areas to reduce the possibility of fire from work operations such as welding.

Firefighting Methodology

Based on the inventory of chemicals and the environmental setting of the facility, the fire department should pre-determine whether a fire should be extinguished or allowed to burn itself out. If it is determined that attempts will be made to a extinguish fire, then the extinguishing materials and methods of application should be specified; e.g. water, foam, etc. The location of needed materials must be identified.

Personnel Protection/Evacuation

Based on the inventory and the firefighting methods to be used, the type of personnel protection equipment needed must be identified. This equipment must be obtained, maintained, and be readily available to response personnel. Any personnel required to use this equipment must be adequately trained.

The plan must describe all aspects of evacuation of persons near the emergency scene including: who will order the evacuation, the geographic area to be evacuated, where evacuees will go, how they will be transported, and who will determine when evacuees can return.

Containment and Treatment of Released Materials

The anticipated flow path of released materials needs to be identified. If an attempt will be made to extinguish a fire with water, the pathway of contaminated runoff water needs to identified. Any water supplies, including groundwater, in this flow path must be identified. The plan should specify how the released materials and/or runoff water will be contained. The location and availability of containment materials and equipment must be specified. If there is no fire or the fire does not consume all spilled materials, neutralization methods and the materials and equipment needed must be identified. Also, the location of any absorbant materials that may be necessary for response must be identified.

Sources of Response Assistance

The plan should identify what assistance is available from private organizations, local, state, and federal agencies. The role of each of these groups must be clearly identified in the plan. It is too late to determine who will do what at the time of the emergency. Methods for contacting these responders on a twenty-four hour per day basis must be included in the plan.

In addition to response assistance, the plan should contain a list of sources of technical or emergency information. Two principle sources are CHEMTREC operated by the Chemical Manufacturers Association, and the National Pesticide Telecommunication Network (NPTN) funded by the EPA and operated by the Texas Tech University School of Medicine. The telephone number for CHEMTREC is 800-424-9300 and the telephone number for NPTN is 800-858-7378.

CHEMTREC can put the caller in communication with the manufacturer of specific pesticides. The NPTN can provide the medical profession with emergency treatment information, information on recognition and management of pesticide poisonings, toxological and symptomatic reviews, pesticide product information, and referrals for laboratory analyses. It can also provide the general public with pesticide information ranging from: product information, protective equipment, safety, health and environmental affects, clean-up procedures, disposal, regulatory laws, etc.

The local response agency should maintain an up-to-date technical reference library of response procedures for the pesticides and other chemicals located in the community. The Selected Bibliography contained in Appendix E of the CEPP Interim Guidance includes a list of some of these publications.

RESPONSE

If adequate and current facility and community contingency plans have been prepared and tested, the actual response to a pesticide emergency should proceed smoothly. Response to pesticide emergencies can be divided into several phases. For purposes of illustration I have divided these into initial phases and secondary or followup phases. The initial phases can include discovery, notification, preliminary evaluation, securing the area, evacuation, and fire suppression. The secondary or follow-up phases can include containment, counter-measures, removal of material, disposal of material, documentation, and cost recovery. Notification is a particularly important aspect of the initial phases. All agencies having a potential involvement in an incident should be notified. Many pesticides are identified as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), more commonly known as "Superfund". A list of these hazardous substances is provided in 40 CFR Part 302. Releases of any of these substances in quantities specified in this regulation are required to be reported to the National Response Center (NRC) at 800-424-8802.

The EPA expects pesticide emergencies to be handled at the lowest level of government possible. As a minimum, first responders must be capable of handling the initial phases. Under certain situations, as defined in the National Contingency Plan, the EPA can conduct some of the secondary phases with funds provided by the CERCLA. This work will be performed by contractors hired by the EPA and can include containment, countermeasures, sampling and analysis, removal, and disposal. A command post can be established if needed.

The key to successful handling of pesticide emergencies is teamwork between the responsible party and any governmental agencies that might be involved. Again, the community contingency plan should identify the respective roles.

The crash of an aerial applicator in Bighorn National Forest near Sheridan, Wyoming is an example of a pesticide emergency which involved several agencies. As a result of this crash, approximately 5,000 pounds of malathion was released in a rugged canyon area containing the headwaters of a stream used as a municipal water supply. Response to the incident involved personnel from the EPA, the U.S. Forest Service, the Wyoming Department of Environmental Quality, the Wyoming Department of Agriculture, the Sheridan County Sheriff's Office, and Sheridan City officials. The team decided to use lime to neutralize the malathion to prevent the contamination of the water supply. This effective response was the result of close coordination and cooperation among the responding agencies.

LEGAL CONSIDERATIONS

The discharge or release of a pesticide into the environment frequently invokes the jurisdiction of state and federal laws and regulations. Many pesticides are identified as hazardous wastes under the Resource Conservation and Recovery Act (RCRA). The transport of any pesticide hazardous waste requires a RCRA permit unless waived in extreme emergency situations. Also, any disposal of a pesticide classified as a hazardous waste must be done in accordance with the current RCRA regulations. Since these regulations will be changing over the next few years, especially those pertaining to land disposal, anyone disposing of hazardous waste pesticides should determine the current regulations.

Regulations promulgated persuant to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) may apply to the disposal of spilled pesticides in certain incidents. Prior to disposal, the appropriate EPA Regional Office should be contacted for clarification on applicability of these regulations. In addition, regulations promugated under the Clean Water Act, the Clean Air Act, and CERCLA may be applicable. Responding parties must be aware of these regulations or know how to contact agency personnel who can provide the appropriate information. In addition to federal statutes on regulations, state and local laws, regulations, and ordinances must be complied with in the disposal of spilled or released pesticides. The disposal of fire debris requires particular attention.

SUMMARY

In summary, the principles for dealing with emergencies involving pesticides are basically no different than the principles for dealing with emergencies involving other environmental pollutants. With adequate contingency planning, training, and adequate preparation, emergencies involving pesticides can be handled in a routine and orderly fashion.

RECONDITIONING CONTAINERS

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The National Barrel & Drum Association (NABADA) represents reconditioners of containers, primarily 55-gallon steel and plastic drums. Our members generally do not recondition packaging smaller than 30 gallons. This is an established industry, and processes 30-40 million drums annually.

Most drums contain some residue of their former contents, and often those residues are hazardous materials. The drum reconditioning industry has been regulated for many years by the U.S. Department of Transportation (DOT), which prescribes specifications for new and reused packaging for hazardous materials (see 49 CFR Parts 173 and 178). Among these requirements are certain quality standards for the drum reconditioning process, including pressure test requirements, registration of parties engaged in the process, and various container markings and certifications.

Under the DOT rules, an emptied container that has not been cleaned must be shipped as if it were full of its former contents, i.e., with all product labels, markings, etc., in place, and all closures tight. If the drum is going to someone other than for reconditioning, it must be accompanied by a certified DOT shipping document (not a manifest) that describes the contents by DOT shipping name, hazard class, and hazard identification number.

EPA has a very workable rule for most hazardous material residues in empty containers, set forth in 40 CFR 261.7. Containers that are empty by this EPA definition are not regulated as hazardous wastes. For most residues a drum must be as thoroughly emptied as possible, but in no case can more than 1" (2.5 cm) of residue remain on the bottom. This does not mean that each drum may contain an inch of residue -- it means the drum must be as thoroughly emptied as possible and, if more material will pour out, then it must be poured out before the container is considered empty. The 1" provision is an override in recognition of the greater viscosity of certain residues.

For residues of acutely hazardous materials listed by name in 40 CFR 261.33(e), however, emptied containers must be triple rinsed with an effective solvent before being deemed to be empty and unregulated.

Emptied drums come to reconditioners from a variety of sources. They can come directly from the emptier, or they can come from unknown sources through the services of dealers who collect them and deliver them to the reconditioner. Those coming directly from the emptier often are transported by the reconditioner in his own trucks, and it is common that a reconditioner's trailer will be parked at the emptier's plant to be loaded by the emptier's employees.

Once received, drums are examined by the reconditioner and then may be washed, or may be put through a pyrolytic chamber and then shotblasted. Dents are removed, chimes are straightened, the container is tested for leaks (7 psi for hazardous materials drums), new gaskets and closures are put in place, and the drum is repainted. Containers that cannot be put back into service are cleaned and crushed in preparation for scrap dealers.

As you know, EPA and approved States manage a permit system for hazardous waste treatment, storage and disposal facilities (TSDFs). Most drum reconditioners are not permitted TSDFs -- these people are professionals engaged in container restoration, not waste treatment. Accordingly, as a matter of law they only can accept containers satisfying EPA's empty container definition. Most reconditioners are hazardous waste generators, but not TSDFs.

Containers that hold hazardous residues and do not meet this definition must be shipped on a hazardous waste manifest, using the services of an appropriately identified hazardous waste transporter, to a permitted TSDF. Shipping a non-empty hazardous waste drum to someone without a TSDF permit constitutes a serious regulatory violation by the generator, the transporter, and the receiving facility. The fact that this violation subjects the generator to punishment gives no comfort to the reconditioner who also may be prosecuted for having received a non-empty drum.

In an endeavor to heighten emptiers' awareness of these liabilities, and of the critical provisions of Section 261.7, NABADA developed and last November its members began to use an "Empty Drum Certification" form. This document must be signed by the emptier or anyone else giving drums to a NABADA reconditioner. It says, "I hereby certify that these drums are 'empty' as that term is defined in the national Environmental Protection Agency regulations, 40 CFR 261.7, and that they have been properly prepared for transportation under the regulations of the U.S. Department of Transportation, 49 CFR 173.29." A copy of this form is attached.

A serious difficulty arises for reconditioners with regard to drums used to ship the particular materials listed in Section 261.33(e) -- i.e., those that must be triple rinsed. This list is a hodge-podge of materials, including liquids, solids and gases. We have been unable to determine with any certainty which of these materials are shipped in commerce at all, much less in 55-gallon drums. Many of the materials, for example, are totally prohibited in transportation under DOT regulations because of their instability (see 49 CFR 172.101 and 173.21).

Under the DOT regulations a shipper must mark the "proper shipping name" on each drum, and this name must remain on the emptied container until it is cleaned. The DOT shipping names, however, do not coincide with the names of the residues listed in 40 CFR 261.33(e). It is not the same as the brand name either. Thus, at least under the regulatory requirements as we perceive them, there is no clear notice to the emptier of the container that his residue is (e)-listed and, therefore, must be triple-rinsed in order to be unregulated under Section 261.7.

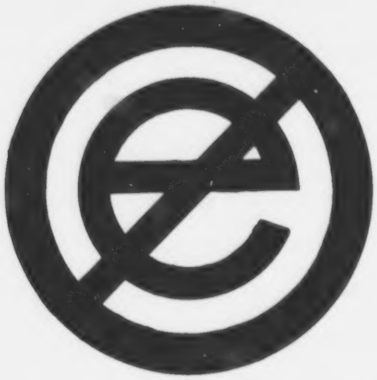
NABADA members' responsibilities and liabilities, and those of the transporter of the emptied container, hinge upon the emptier recognizing his material as being Section 261.33(e)-listed, and yet there is nothing in the regulations that provides a signal to him of this fact. This lack of a visual signal also leaves the reconditioner with no ready mechanism to double-check incoming containers for (e)-listed residues.

NABADA has discussed this with the Chemical Manufacturers Association, and I am raising it today for your consideration in this forum on pesticide container management. What is needed is a visual signal to the emptier, the transporter, and the receiving facility (whether it be a drum reconditioner, dump, scrap yard) that this container must be triple-rinsed or else it is a fully regulated hazardous waste.

NABADA is not proposing a lengthy advisory statement. Frankly, none of the truck drivers or other personnel involved has the time or the professional background to discriminate between multisyllabic chemical names. NABADA perceives a need for a simple visual stimulus that conveys this message quickly, effectively, and preferably without having to touch the container.

As a responsible association, NABADA members believe it is inappropriate to complain about a problem without proposing a solution.

NABADA suggests use of a consistent signal such as that attached to this paper, which is takes the form of a lower case "e" in a circle with a slash through it. This has the benefit of not duplicating any other symbols in use, and being easy to apply and to recognize, even when upside down.



NABADA is not suggesting this is the only possible solution. This industry is suggesting, however, that there is a communications gap here, and that something must be done to close that gap other than by requiring the 261.33(e) chemical name to be marked on the container. NABADA seeks industry's involvement in the solution. If it appears that a government rule is necessary, NABADA is prepared to petition DOT and EPA for such rule making.

EMPTY DRUM CERTIFICATION

I hereby certify that these drums are "empty" as that term is defined in the national Environmental Protection Agency regulations, 40 CFR 261.7*, and that they have been properly prepared for transportation under the regulations of the U.S. Department of Transportation, 49 CFR 173.29.**

Date: ________ ______________________________

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*With regard to most regulated residues, EPA's 40 CFR 261.7 says: "A container . . . is empty if:

> (i) All wastes have been removed that can be [illegible] using the practices commonly employed to remove [illegible] that type of container, e.g., pouring, pumping, and [illegible]
>
> (ii) No more than 2.5 centimeters (one inch) of [illegible] on the bottom of the container. . . ."

EPA has explained this rule, saying that "one inch of waste material is an overriding constraint and may remain in an empty container only if it cannot be removed by normal means. The rationale for this provision is that there are certain tars and other extremely viscous materials that will remain in the container even after the container is emptied by normal means."

For residues of products specifically listed by name in 40 CFR 261.33(e), EPA says the container is empty only "if the container . . . has been triple-rinsed using a solvent capable of removing" the product, or has been cleaned by another method shown to achieve equivalent removal.

**DOT's 49 CFR 173.29 says that all openings on the empty container must be closed, and that all markings and labels must be in place as if the drum were full of its original contents. A DOT shipping paper is not required for transportation of a drum for reconditioning via contract or private motor carrier. DOT placarding is not required for vehicles carrying empty containers.

RECYCLING METAL CONTAINERS

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In order to understand the problems related to the recycling of pesticide containers, it is essential that those not familiar with metallic recycling in general at least obtain a passing insight into the industry.

Metallic recycling is a big business composed, in the main, of many small businesses which take the metallic discards of society and convert them into feed ingredients for steel mills, foundries and refiners.

The process of recycling metals provides vast tonnages of feed materials. For example, steel scrap purchased by consumers will approximate 50 million tons in 1985. Non-ferrous scrap tonnage, while of lower magnitudes, accounts for very impressive annual volumes.

Recyclable metals are a vital ingredient in metal manufacturing and they also possess very important public benefits. For example, making a ton of steel from recyclable scrap instead of virgin iron ore results in a saving of 74% of the energy that would otherwise have been used, as well as large reductions in water use and water and air pollution. It clearly is in the public and private interest to maximize recycling, yet that is not the case -- and not the case by a very large margin.

The volume of recyclable but not recycling metallic scrap is staggering. It has been conservatively estimated that approximately 800 million tons of scrap iron now available to be recycled are not moving for want of a market. And that is the key factor that must pervade all further discussion -- the need for a market for recycling to be undertaken successfully.

Because of this lack of sufficient demand to consume the newly generated scrap iron arising in the economy each year, there is this huge and ever-growing inventory -- an involuntary inventory that just keeps getting larger -- it now equals more than 15 times the annual use rate of 1985. The result is that only the most readily available, and the most desirable, scrap is recycled -- the rest is consigned, involuntarily, to the inventory.

That would be important even if there were no problems with residues since container scrap is not generally considered the highest grade scrap material. When the weak and over-supplied market is complemented by the threat of potential hazardous waste contamination, the viability of metal container recycling is markedly lessened to the point that a problem quickly surfaces.

Namely, the problem at issue -- empty containers that are not recycling.

A container is empty under the applicable regulations if: (1) all non-acutely hazardous wastes have been removed that can be removed using the practices commonly employed to remove materials from that type of container ,*e.g.*, pouring, pumping, and aspirating, and (2) no more than 2.5 cm (1 inch) of residue remain on the bottom of the container or inner liner.

The key word is and; there must be both a complete draining of the container and no more than 1 inch remaining as a residue.

If these requirements are met, a container is legally empty. I must add, however, that EPA has ruled that where residue is deposited on the sides or top of a container, the total amount of material in the container will be considered in measuring the "bottom coating." Thus, the apparently "simple" rule gets more complicated.

Finally, the requirements for a container to be considered empty where it has held an acutely hazardous waste, are more stringent, requiring triple rinsing. Of course, many pesticides are classified as acutely hazardous wastes.

If the container is a 5 or 10 gallon labeled can, the problems are serious but the person considering handling the container would, at least, have a pretty good indication of the nature of the residues (assuming limited re-use of that container) and, whether the container had to be triple rinsed or not.

On the other hand, if the container is a barrel or drum, the odds rise sharply that other materials have been in the container for at least some of the time after its original use was finished. The possible introduction of other -- and unknown -- materials into barrels and drums during their life cycle -- in addition to the original filling -- makes the risk of threatening residues far higher.

For example, assume the container is legally "empty." How can the processor know that the residue remaining is from the original material (which may or may not be a hazardous waste) or is the result of some other use of the container, a use which may have left a totally different -- and hazardous -- residue to address? How can the processor know that the barrel or drum should have been triple rinsed if it was re-used to handle discarded commercial chemicals? How can he ascertain that the alleged triple rinsing actually took place? What is his responsibility in that regard?

These and other such questions quickly lead most processors to conclude that a load of barrels or drums or other containers of unknown or uncertain origin are products that pose too great a potential threat to be considered viable, unprepared materials that they would be willing to process.

The problem goes beyond RCRA legal requirements to manage properly the containers themselves. Far more serious is the potential for contamination of plant and processing residues with the resultant obligations and liabilities under both RCRA and especially Superfund.

If the processing of containers would contaminate processing residues, it is an unacceptable situation for the processor. Scrap processing waste flows, with very few specific exceptions, are non-hazardous and the industry intends to keep it just that way. There is no return from handling containers if it leads (or could lead) to possible contamination of processing residues. The only viable and realistic option is to not handle that material.

Because of the strict and absolute liability associated with Superfund, and the clear risk that the residue of 1 inch or less (even if not an acutely hazardous waste) could contaminate a processing facility (and the contamination potential grows in proportion to the number of 1 inch residues found in such containers), scrap processors have been forced to re-think the advisability of handling such containers as recyclable items.

Indeed, some processors have totally banned the purchase or acceptance of barrels, drums or containers where they "might have" contained hazardous wastes or other hazardous substances. Some processors have opted to accept such containers only from known sources where the processor has been assured and feels confident that the cleaning procedures have been followed and "no residues remain that might be released in processing." Finally, some have agreed to accept containers if they are accompanied with certifications and indemnifications when the documents are signed by financially responsible parties.

Processors know that under Superfund there is no realistic defense if a hazardous substance is present and requires a clean-up. Thus, the processors are either saying "no" to any material that might possess such a threat or they are taking steps to assure themselves that financially responsible parties certify the "clean" status of the containers and, thereby, assume at least some of that liability if their certification is incorrect. The Institute's suggested certification includes an indemnification provision whereby the seller agrees to indemnify the processor if the warranty is breached.

The Institute is also cautioning its members to not assume any unnecessary risk and if that means turning away business that had been realistic in the past, so be it. The threat of a superfund clean-up is so large (and so uninsurable) that processors cannot take on that risk as a reasonable business practice.

The Institute is also working to stop the continued introduction of hazardous materials into products entering the economy so that at some time in the future, the flow of hazardous waste threatening materials will cease (or at least be sharply reduced). For example, the Institute has mounted a major program directed at eliminating the use of cadmium as a coloring medium for many household appliances. There certainly are available many other pigmentation sources without the need to use cadmium and create thereby a hazardous waste potential.

Likewise, the use of cadmium as an anticorrosive agent on selected bolts in the frame of an automobile, is not supportable when evaluated against the threat such cadmium poses as a potential hazardous waste. If Swedish cars can be made without cadmium, why can't we make cars similarly protected against corrosion with non-hazardous metals? Obviously we can, and it is an Institute goal to raise sharply the awareness of designers that when quality, salability, durability and appearance are considered in designing a product, so also must the concept of recyclability be considered with as much emphasis and concern.

And the same logic holds true in the matter of solder where there is no need to continue using solder composed of 60% lead and 40% tin thereby providing the basis for long-term hazardous waste generation from many sources.

When recyclability is designed into products at the start, the problems of hazardous waste contamination threats will lessen markedly.

Now that you know why the market for recycling metallic containers is declining, and why controlling hazardous wastes will only succeed when hazardous materials, which lead to hazardous wastes, are limited in the economy, is there a solution?

Yes, the emphasis on design for reasons other than recyclability must be reversed. Does this mean the need to consider a new generation of pesticides that do not possess the potential for hazardous residues? Does it mean a change in pesticide concept? Does it mean a change in pesticide distribution procedures? Does it mean a "return container" program of some sort whereby parties would assure that all such containers offered for recycling have been cleaned of any potentially hazardous residue? Does it mean that things must change?

It most likely means all of the above and then some. What it also means is that the scrap processing industry will not become a potential hazardous waste dumping ground. The industry will not allow others to ship questionable materials to it for recycling. The scrap processor did not put the hazardous material in the container and he will not be made to account for the residue that remains after the container has served its useful purpose.

DISPOSAL OF 55-GALLON ALL-PLASTIC DRUMS

DANIEL W. BARBER

CHAIRMAN REUSE COMMITTEE

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The Plastic Drum Institute is a division of the Society of the Plastics Industry and is composed of member companies which manufacture industrial plastics shipping containers with a liquid capacity of 3 US gallons and above, as well as manufacturers of raw materials for such containers.

The SPI, in turn, is the principal trade association for the plastics industry with more than 1,800 member companies accounting for over 75 per cent of the sales of plastics in the US and over 95 per cent of the resin produced in the US.

MANUFACTURING PROFILE

There are 18 companies producing 55-gallon all-plastic drums. Production is conducted at 23 separate manufacturing locations across the country and in Canada.

REGULATORY STATUS, ALL-PLASTIC 55 GALLON DRUMS

On June 12, 1984, the U.S. Department of Transportation granted full recognition to 55 U.S. gallons, non-removable head all-plastic drums for the shipment of hazardous materials which include corrosive liquids, Class B Poisons and chemically compatible flammable liquids.

This recognition occurred following ten years of actual usage in the above referenced substances, with surveillance by D.O.T. Performance has been excellent as demonstrated in the integrity and safety of containers with hazardous materials over a broad range of distribution and environmental conditions through the 10-year period.

HM-185, which authorized a 55-gallon all-plastic drum, is also referred to as "Standards for Polyethylene Packagings; Final Rule". Three paragraphs of this document are significant to our discussions.

173.24 - Standard requirements for all packages

(4) Each polyethylene packaging used as an outside packaging for materials meeting the definition of a poison according to this subchapter shall be permanently marked, by embossment or other durable means, with the word "POISON" in letters of at least 1/4 inch in height. Additional text or symbols may be included in the marking. The marking shall be located within six inches of the packaging's closure. The requirements of this subparagraph do not apply prior to September 1, 1985.

173.28 - Reuse of packagings (Containers)

(d) Packagings previously used for any hazardous material must have the old markings (other than markings which are required by this subchapter to be permanent) and labels, if any, thoroughly removed or obliterated before being used for other materials.

(i) Polyethylene packagings previously used for poisonous materials should not be reused for any materials other than poisonous materials or hazardous wastes.

FOCUS OF TODAY'S DISCUSSION

Integrity of container performance is the primary objective of the PDI and its member companies. Our concern extends beyond the first time shipment, to secondary service, to the final disposal of the spent container.

The activities on these important subjects are as follows:

REUSE

All-plastic drums conforming to U.S. DOT Specification 34 are authorized to be used in secondary service. The details of the requirement are that the drum comply with specification and performance requirements.

Our group initiated a study on the ability of reconditioning to neutralize all-plastic containers from the previous lading packaged, in order to safely use the drum in subsequent service.

- Objective - The purpose of this study was to determine the ability of drum reconditioning to neutralize an all-plastic drum from the previous lading packaged, in order to safely reuse the drum in subsequent service.
- Conclusions - Tests examining the effect of various ladings on the container material indicate:

  1. The laundering process was, in general, successful, efficient, effective and had no adverse effects on the drum;
  2. Minimal residue from previous ladings remain in the laundered drum sidewall. For example, the maximum residue remaining in the drums for the products tested was less than 0.017% of the weight of the laundered drum.

"REAL WORLD REUSE" TEST

- Assembled to determine under field conditions the feasibility of utilizing reconditioned all plastic drums in secondary service.
- Member organizations of the Task Force are:
  - National Barrel and Drum Association, Inc.
  - Petroleum Packaging Committee of the Packaging Institute
  - Chemical Packaging Committee of the Packaging Institute (Observer's status).
  - Plastic Drum Institute of the Society of the Plastics Industry, Inc.

What are the reasons for reusing all-plastic drums?

- Utilization of a valuable resource,
- Reduction in packaging costs.

The "Task Force" has designed a program which will, under actual conditions, confirm the feasibility of utilization.

The evaluation will consist of the following steps:

- One member company from each of NABADA's five regions, eastern, southern, central, western and Canadian, will randomly select, from their inventory of used all-plastic drums (blue pigmented), six units which have been in a one-time shipment (date of manufacture on the drum will confirm this) of the following six ladings which were subjects of the PDI Reuse Study.

Acrylic Acid	Sulfuric
Mineral Spirits	Acetic Acid
Methanol	10W40 Lubricating Oil

- At this point, shippers who have expressed an interest in utilizing reconditioned all-plastic drums will be furnished containers for a three and six month storage test of ladings they are interested in shipping.

- The drums will be permanently branded on the top head with a test code number which will identify the original lading and the reconditioner.
- The drums will then be reconditioned under guidelines from NABADA's Plastic Drum Committee which will cover drum interior, exterior, closures and final inspection.
- Following each test period, the lading will be assayed by the filler for confirmation to their specifications, emptied, neutralized by rinsing with water and returned to the reconditioner from whom they received the test drums.
- Upon receipt of the test drum, the responsible drum conditioner will again process the drum under NABADA's guidelines.
- Arrangements will then be made for shipment to a central test location for evaluation by the "Reuse Task Group".
- Evaluation will include:

  -Competent Authority periodic tests.

  -Visual inspection.
  -Cut in half for internal inspection.

FINAL DISPOSAL - 22 POUNDS OF POLYETHYLENE

The final disposal of an all-plastic container is a subject which must and is being addressed. I have purposely referred in the heading to disposal of a drum as 22 pounds of polyethylene in order to highlight the fact that the material is recyclable and, therefore, has value.

The value is in the manufacture of secondary products such as traffic barrier cones, golf bag liners, trash cans, and signs. Such products are being produced today in the United States from recycled material; the list will expand as it is limited only by the imagination of designers.

Recycled material is also an important source of fuel. The energy value of material from a 55-gallon drum is three times that of an equal amount of coal. An example is a firm in Ohio which processes recycled material into pellets which are used as an auxiliary fuel in industrial furnaces.

Recycling of plastics from packaging is receiving attention from both resin producers and container users, this is demonstrated in the founding of an organization known as the PLASTIC RECYCLING FOUNDATION, a non-profit corporation to fund research and develop plastic recycling technologies to stimulate growth of the plastic recycling industry. The new Plastic Recycling Institute has been funded by the foundation to conduct research with the following objectives:

- Improving recycling system efficiencies,
- Improving tne quality of recycled materials,
- Developing the recycling processes for various materials,
- Sharing the technology with the recycling industry.

Initial research will occur at Rutgers University in New Brunswick, New Jersey with emphasis on consumer-type packaging, such as the PET bottle.

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
PERMITTING OF ON-SITE PESTICIDE WASTE STORAGE AND TREATMENT

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ABSTRACT

Pesticide users faced with disposal problems related to pesticide residues have a variety of options to choose from which allow them to comply with hazardous waste laws. The options range from on-site storage, treatment and disposal to off-site treatment or disposal. On-site options for pesticide users which generate more than 1 kilogram per month of acutely hazardous commercial chemical products found in the RCRA E List, 40 CFR 261.33(e), or 1000 kilograms per month of any waste as defined in 40 CFR 261.31, 32, or 33, will require a RCRA hazardous waste permit for treatment or storage over 90 days. In Table 1, are found the pesticide ingredients from the RCRA E and F Lists. This paper will present items which must be considered if on-site storage and treatment options are to be implemented for managing pesticide residues.

DISCUSSION

The 1984 amendments to RCRA require that EPA evaluate and determine if certain hazardous wastes should be banned from land disposal. Included in this evaluation will be all the E List pesticides and RCRA F List pesticides and inert pesticide ingredients (40 CFR 261.33(e) and (f)). If banned from land disposal, only treatment or incineration will be available for disposal of pesticide residues. It is the opinion of the author that on-site incineration will not be feasible for the single pesticide user which generates small quantities of waste. Therefore incineration will not be addressed in this paper.

Pesticide users will usually find themselves having to store residues until a sufficient volume has been accumulated to make treatment economical. If the amount of waste in storage exceeds 1 kilogram for E List wastes or 1000 kilograms for other RCRA wastes and is stored for more than 90 days, a RCRA permit will be necessary for storage and or treatment. Treatment is defined in 40 CFR 260.10 as "any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume."

The standards which must be met before receiving a RCRA permit are found at 40 CFR 264. The specific information necessary in the permit application is found in 40 CFR 270, Subpart B. A synopsis of the design standards which would be required for a facility seeking a hazardous waste storage permit for storage in containers and/or tanks is below:

Container Storage (Requirements found in 40 CFR Subpart I):

Container storage areas which contain liquid wastes in containers must have a containment system. The containment system must be designed as follows:

(1) A base must underlie the

containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;

(2) The base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;

(3) The containment system must have sufficient capacity to contain 10% of the volume of containers or the volume of the largest container, whichever is greater.

(4) Run-on into the containment system must be prevented unless the collection system has sufficient excess capacity in addition to that required in paragraph (3) to contain any run-on which might enter the system.

Tank Storage (Requirements found in 40 CFR Subpart J):

Tanks for storage of hazardous wastes must have sufficient shell strength and, for closed tanks, pressure controls (e.g., vents) to assure that they do not collapse or rupture. This tank requirement is currently proposed to change (see Federal Register, Vol 50, No. 123, June 26, 1985) and include secondary containment for above and below ground tanks or ground water monitoring and leak testing only for underground tanks. The proposed change would also require full secondary containment of generators which store for 90 days or less. The proposed tank design requirements are synopsized and are presented below:

The secondary containment system must be designed to:

(1) Prevent any migration of wastes or accumulated precipitation out of the tank system to the soil, ground water, or to surface water at any time during the use of the tank system;

(2) Detect and collect any releases of waste and accumulated precipitation until the collected material can be removed;

(3) Remove or permit the removal of spilled or leaked waste and accumulated precipitation in as timely a manner as is necessary to prevent releases from the secondary containment system.

To meet the requirements above, all secondary-containment systems must be at a minimum:

(1) Constructed of or lined with materials that are compatible with the waste(s) to be placed in the tank system and must have sufficient strength and thickness to prevent failure owing to pressure gradients (including static head and external hydrological forces), physical contact with the waste to which it is exposed, climatic conditions, the stress of installation, and the stress of daily operation (including stresses from nearby vehicular traffic);

(2) Placed on a foundation or base capable of providing support to the secondary containment system and resistance to pressure gradients above and below the system and capable of preventing failure owing to settlement, compression, or uplift;

(3) Provided with a leak-detection system that is designed or operated so that it will detect the presence of any release of hazardous waste or accumulated liquid in the secondary containment system within 24 hours of entry of the liquid into the system;

(4) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation;

(5) Designed or operated to contain 110 percent of the design capacity of the largest tank within its boundary;

(6) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity in addition to that required in paragraph (5) to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25 year, 24 hour rain storm.

Secondary containment for aboveground, inground, and underground tanks must include one or more of the following devices:

(1) A liner (external to the

tank);

(2) A vault;

(3) A double-walled tank; or

(4) An equivalent device as approved by the Regional Administrator.

In addition to the requirements above, liners, vaults, and double-walled tank systems must satisfy the following requirements:

(1) External liner systems must be:

(i) Free of cracks or gaps; and

(ii) Installed to cover all surrounding earth likely to come into contact with the waste if released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste).

(2) Vault systems (concrete) must be:

(i) Constructed as a continuous structure with chemical resistant water stops in place at all joints (if any);

(ii) Provided with an interior coating that is compatible with the stored waste for the purpose of preventing migration of waste through the concrete and also an exterior moisture barrier to prevent migration of moisture into the vault; and

(iii) Provided with a noncorrosive porous fill material around the tank if the waste being stored meets the definition of ignitable waste under 40 CFR 261.21.

(3) Double-walled tanks must be:

(i) Designed as an integral structure (i.e., an inner tank with an outer shell) so that any release from the inner tank is contained by the outer shell;

(ii) Protected if constructed of metal, from both corrosion of the primary tank interior and of the external surface of the outer shell; and

(iii) Provided with a built-in leak monitor

Ancillary equipment associated with tanks must be provided with secondary containment (e.g., trench, double-walled piping) that meet the above secondary containment requirements.

Treatment

When evaluating treatment options, several regulatory issues need to be considered. Wastes identified in the RCRA E and F Lists and those listed in 40 CFR 261.31 and 32 are known as listed wastes. Mixtures of these wastes remain listed wastes regardless of the concentration of the waste. When treating these wastes, the treatment residues and treated fluids are also listed wastes and are subject to regulation unless they are delisted by a state or federal environmental agency. Delisting actions require extensive effort by an applicant and should not be taken lightly. An option available for disposal of treated fluids is to contact the local public waste water treatment facility and secure a permit for discharging treated fluids into their system. This method of disposal does not require a RCRA permit. If treated fluids can be discharged to the waste water treatment facility, on site treatment will result in reducing the volume of wastes to only the treatment residues which would still require disposal as hazardous waste. Otherwise, on-site treatment will result in greater volumes of waste being generated unless treatment residues or treated fluids are delisted.

CONCLUSION

On site options for storage and treatment of pesticide residues where a RCRA permit is required can result in an extensive investment of time and effort by a pesticide user while securing the permit. For a user which generates small volumes of waste, the economics of acquiring such a system may not be worth the effort. This type of generator may be best served by "milk run" or transfer station services offered by waste management companies. As demand increases for these services, they will become more available and should serve as a solution to the pesticide users problem of pesticide residue disposal.

TABLE 1

PESTICIDE ACTIVE INGREDIENTS THAT APPEAR ON THE RCRA "ACUTELY HAZARDOUS COMMERCIAL PRODUCTS" LIST (THE RCRA E LIST)

Acrolein
Aldicarb
Aldrin
Allyl alcohol
Aluminum phosphide
4-Aminopyridine
Arsenic acid
Arsenic pentoxide
Arsenic trioxide
Calcium cyanide
Carbon disulfide
p-Chloroaniline
Cyanides (soluble cyanide salts)
Cyanogen
2-Cyclohexyl-4,6-dinitrophenol
Dieldrin
0,0-Diethyl S-[2-ethylthio)ethyl] phosphorodithioate (disulfoton, Di-Syston^{R})
0,0-Diethyl 0-pyrazinyl phosphorothioate (Zinophos^{R})
Dimethoate
0,0-Dimethyl 0-p-nitrophenyl phosphorothioate (Methyl parathion)
4,6-Dinitro-o-cresol and salts
4,6-Dinitro-o-cyclohexylphenol
2,4 Dinitrophenol
Dinoseb
Endosulfan
Endothall
Endrin
Famphur
Fluoroacetamide
Heptachlor
Hydrocyanic acid
Hydrogen cyanide
Methomyl
alpha-Naphthylthiourea (ANTU)
Nicotine and salts
Octamethylpyrophosphoramide (OMPA, schradan)
Parathion
Phenylmercuric acetate (PMA)
Phorate
Potassium cyanide
Propargyl alcohol
Sodium azide
Sodium cyanide
Sodium fluoroacetate
Strychnine and salts
0,0,0,0-tetraethyl dithiopyrophosphate (sulfotepp)
Tetraethyl pyrophosphate
Thallium sulfate
Thiofanox
Toxaphene
Warfarin
Zinc phosphide

There are currently no inert pesticide ingredients on the RCRA E List.

TABLE 1

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PESTICIDES AND INERT PESTICIDE INGREDIENTS CONTAINED ON THE RCRA TOXIC COMMERCIAL PRODUCTS LIST (RCRA F LIST)

Active Indredients

Acetone
Acrylonitrile
Amitrole
Benzene
Bis(2-ethylhexyl)phthalate
Cacodylic acid
Carbon tetrachloride
Chloral (hydrate)
Chlordane, technical
Chlorobenzene
4-Chloro-m-cresol
Chloroform
o-Chlorophenol
4-Chloro-o-toluidine hydrochloride
Creosote
Cresylic acid (cresols)
Cyclohexane
Cyclohexanone
Decachlorooctahydro-1,3,4-metheno-2H-cyclobuta[c,d]-pentalen-2-one (Kepone, chlordecone)
1,2-Dibromo-3-chloropropane (DBCP)
Dimbutyl phthalate
S-2,3-(Dichloroallyl diisopropylthiocarbamate) (diallate, Avadex)
o-Dichlorobenzene
p-Dichlorobenzene
Dichlorodifluoromethane (Freon 12^{R})
3,5-Dichloro-N-(1,1-dimethyl-2-propynyl) benzamide (pronamide, Kerb^{R})
Dichloro diphenyl dichloroethane (DDD)
Dichloro diphenyl trichloroethane (DDT)
Dichloroethyl ether
2,4-Dichlorophenoxyacetic, salts and esters (2,4-D)
1,2-Dichloropropane
1,3-Dichloropropene (Telone)
Diethyl phthalate
Epichlorohydrin (1-chloro-2,3-epoxypropane)
Ethyl acetate
Ethyl 4,4'-dichlorobenzilate (chlorobenzilate)
Ethylene dibromide (EDB)
Ethylene dichloride
Ethylene oxide
Formaldehyde
Furfural
Hexachlorobenzene
Hexachlorocyclopentadiene
Hydrofluoric acid
Isobutyl alcohol
Lead acetate
Lindane
Maleic hydrazide
Mercury
Methyl alcohol (methanol)
Methyl bromide
Methyl chloride
2,2'-Methylenebis (3,4,6-trichlorophenol) (hexachlorophene)
Methylene chloride
Methyl ethyl ketone
4-Methyl-2-pentanone (methyl isobutyl ketone)
Naphthalene
Nitrobenzene
p-Nitrophenol
Pentachloronitrobenzene (PCNB)
Pentachlorophenol
Phenol
Phosphorodithioic acid, 0,0-diethyl, methyl ester
Propylene dichloride
Pyridine
Resorcinol
Safrole
Selenium disulfide
1,2,4,5-Tetrachlorobenzene
1,1,2,2-Tetrachloroethane
2,3,4,6-Tetrachlorophenol
Thiram
Toluene
1,1,1-Trichloroethane
Trichloroethylene
Trichloromonofluoromethane (Freon 11^{R})
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)
2,4,5-Trichlorophenoxypropionic acid (Silvex)
Xylene

RCRA F List (continued)

Inert Ingredients

Acetone
Acetonitrile
Acetophenone
Acrylic acid
Aniline
Benzene
Chlorobenzene
Chloroform
Cyclohexane
Cyclohexanone
Dichlorodifluoromethane (Freon 12^R)
Diethyl phthalate
Dimethylamine
Dimethyl phthalate
1,4-Dioxane
Ethylene oxide
Formaldehyde
Formic acid
Isobutyl alcohol
Maleic anahydride
Methyl alcohol (methanol)
Methyl ethyl ketone
Methyl methacrylate
Naphthalene
Saccharin and salts
Thiourea
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloromonofluoromethane (Freon 11^R)
Vinyl chloride
Xylene

OFF-SITE DISPOSAL OF PESTICIDES AND PESTICIDE CONTAINERS

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ABSTRACT

The Governmental Refuse Collection and Disposal Association (GRCDA) has a membership of whom about 70% are engaged in solid waste management at the local government level. These governments, along with private industry, provide the non-hazardous waste landfills which pesticide end-users such as exterminators, commercial applicators, and farmers have often utilized for disposal of empty containers and/or pesticides in the past. New regulations governing hazardous waste disposal, changing regulations governing landfill design and operation, citizen attitudes and related factors are tending to eliminate local solid waste management facilities as recipients of pesticide wastes. This discussion will review what are the current pressures on local disposal systems and what actions might be taken to assist both the disposal system owner and the pesticide waste generators.

INTRODUCTION

While the Governmental Refuse Collection and Disposal Association (GRCDA) represents both the public and private sectors of solid waste management, this paper will focus on the public issues which affect both publicly and privately owned solid waste collection and disposal systems which are destined to handle non-hazardous wastes.

Some appreciation of the complex interfaces between the Federal regulations concerning pesticides may be gleaned from reviewing the paper presented by Raymond F. Krueger last year (1). The paper reviews the difficult to interpret relationships between the Resource Recovery and Conservation Act (RCRA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

This paper will focus on the RCRA issues which significantly affect the ability of local disposal sites to cope with waste pesticides and waste pesticide containers.

RCRA regulates hazardous wastes under Subtitle C and non-hazardous wastes under Subtitle D. The Subtitle D regulations apply to all local disposal sites whether public or private. In addition, local sites are also subject to regulation by the respective states as well as local governmental jurisdictions. The combination of these factors dictates much of the regulation and policy under which local disposal sites operate. These factors determine what wastes can be managed at these sites regardless of the specific regulations which may apply to any category of wastes, i.e. hazardous or non-hazardous.

The issues of disposal of waste pesticides versus waste pesticide containers must be distinguished at the onset. Under RCRA and other accepted guidelines, empty pesticide containers which have been triple rinsed are considered to be empty and therefore, non-hazardous. Waste pesticides are viewed by the public as hazardous regardless of their designation under either RCRA or FIFRA. From a realistic point of view, empty containers will be perceived as significantly different from waste pesticides in terms of both degree of hazard and acceptable methods of disposal.

In order to be able to consider some of the possible options available, one must first consider the restrictions which are in place at the present time, those changes which can be anticipated, and any public perceptions which might affect pesticide disposal processes.

RCRA-SUBTITLE C

RCRA regulates both hazardous and non-hazardous wastes. While household and certain other wastes are exempted, all other hazardous wastes must be disposed of at a hazardous waste management facility permitted under RCRA. There are a limited number of these sites in the country and shipping and disposal costs can be very expensive.

However, under RCRA any material "that is normally applied to the land" may be disposed of by land application. It may be assumed that any pesticide that may normally be applied to the land could be disposed of in this way if the label instructions for application were followed. That is to say that normal spray concentrations could be so used but not the concentrate. It would appear that this process could be followed whether or not a pesticide application was needed. This process is worth emphasizing as an allowable RCRA activity which could be conducted off-site as well as on-site.

Domestic sewage and wastes treated at municipal or industrial wastewater treatment plants regulated under the aegis of the Clean Water Act are also exempted under RCRA. Small quantity generator surveys conducted by GRCDA have found that some pesticides are disposed of via this route by some small businesses, principally exterminators. In general, such disposal is not permitted except with the specific permission of the local sewer authority. The pesticides, in the quantities involved, must not (1)damage the transport system (sewers, pumps, etc.); (2)damage the treatment processes; or (3)cause the plant to be in violation of its discharge requirements. As may be realized, most sanitary authorities are reluctant to give permission for discharge of pesticide of any kind into their system even if such a process is both legal and environmentally sound.

Unfortunately, GRCDA also found that some generators who were exempted under RCRA disposed of waste pesticides into their septic systems. This process is legal under RCRA, may or may not be legal under state and local regulations, and should be viewed as environmentally unsound in almost all cases.

It also appears that, under RCRA, waste pesticides can legally be returned to the manufacturer for reprocessing, recycling, etc. if all the applicable U. S. Dept. of Transportation shipping regulations are met.

In summary, if a pesticide is classified either now or in the future as a hazardous waste under RCRA, limited off-site disposal options are available and then, only under certain conditions.
The options are:

- Disposal at a RCRA HW disposal site
- Land disposal as specified
- Wastewater treatment plant if allowed
- Return to manufacturer

RCRA-SUBTITLE D

Under Subtitle D of RCRA, the Environmental Protection Agency (EPA) has developed national criteria for the proper operation of non-hazardous waste land disposal facilities (landfills). At the current time, EPA does not have authority for direct enforcement of these criteria; however, the criteria may be enforced in Federal District Courts when suits are brought by appropriate parties. When RCRA was reauthorized by Congress in the fall of 1985, EPA was directed to study the problems which may arise from the fact that local landfills have accepted hazardous wastes from households, other sources exempted under RCRA, and possibly illegal sources in the past. The EPA is to report on problems, needed regulations, cost of enforcement, etc. Also, the EPA will have enforcement authority for any future criteria and/or regulations as they currently have under Subtitle C. This new program regulating non-hazardous disposal sites would be in place by about 1988.

While many issues have to be resolved, it is possible that local landfills might have to retrofit existing sites to comply with the new design standards under certain conditions. Other sites would probably have to close. For these reasons alone, local landfill owners and operators will become increasingly wary of accepting any wastes which might cause issues to be raised in the future.

PUBLIC ATTITUDES

Public perceptions and attitudes are such that it has become very difficult to obtain approval for new disposal sites, resource recovery facilities, and other types of solid waste management facilities. Some national surveys have shown that the majority of Americans feel that toxic waste disposal is our number one environmental problem. For these reasons it is almost impossible to assume that the general public will knowingly permit the disposal of any pesticides at local landfills whether they are publicly or privately owned.

Elected and appointed officials are becoming more sensitive to these issues and are beginning to look much more closely at what they are handling in their solid waste systems. Private landfill owners are concerned about future regulatory issues, maintaining current permits, and not generating public opposition to their operations. Therefore, the management of hazardous wastes at local disposal sites is becoming less likely each month that passes even though such management might be permitted under federal, state, and local law. Many communities are even beginning to address hazardous wastes generated at the household level.

PESTICIDE CONTAINERS

Under RCRA, containers that are defined as being empty are not considerd to be hazardous wastes. The classic example of empty is that imposed upon farmers, namely, the containers must be triple rinsed. This definition is actually more strict than other definitions of empty under RCRA; however, it seems that this is the definition which has stuck in the minds of the public.

Empty containers constitute a real disposal problem for many pesticide users. More and more local disposal sites will not accept these containers under any conditions. In addition many local collectors are beginning to be presured by disposal site owners and are refusing to pick up pesticide containers.

If it is both legal and environmentally sound to dispose of empty pesticide containers at local disposal sites, why are they being refused? There appear to be several reasons. The principal reason is, in the past, many of the containers were not empty! Not too long ago I visited a landfill in an agricultural community and saw large quantities of farm wastes including pesticides and other chemicals. The operators of the landfill reported that sometimes the chemicals would kill the seagulls that came to the site. This may be an extreme example; however, it does show that pesticides have been in the past and are currently being disposed of at local landfills.

If the containers were truly empty, would the local landfills accept them? In many or possibly most cases, probably not. Why is this the case? The principal reason is that most disposal operations are poorly equipped to confirm that supposedly empty containers are indeed truly empty. Confirmation is virtually impossible if the containers are brought to the site mixed with other wastes. If this impasse is to be overcome, the pesticide using industries must establish working relationships with the waste disposal facilities. This would seem to be realistic and the result would benefit both parties. Local governments would like to provide disposal services for local businesses and taxpayers and private sites would welcome the income.

GRCDA feels that realistic programs could be developed whereby local landfills would accept empty pesticide containers if certain conditions were met. Obviously, these arrangements would have to be made beforehand. Minimum conditions might include the following:

- o Empty pesticide containers must be brought to the site as separate, discrete loads.
- o All containers would be open and displayed so that easy and rapid visual inspection of the containers could be made by disposal site personnel. This might require cutting of some containers.

- The disposers should be prepared to pay the cost of examination by the facility's employees or any other reasonable fee imposed by the facility.

Under these conditions it is reasonable to assume that local solid waste management systems, elected officials and the public-at-large would have no legitimate objection to the disposal of empty pesticide containers. We believe that most of our members would agree with this position. In many cases it would require preliminary discussions between the potential disposers and the system owners or operators. These discussions could be held by individual waste generators, but it would be better if a trade association or other organization representing the disposers initiated the discussion.

SUMMARY

In the near future it will become difficult if not impossible for generators of waste pesticides and waste pesticide containers to manage these wastes via the local solid waste management systems. This is due to a combination of factors including past abuses of the systems, new regulations at all levels of government, and public attitudes concerning hazardous waste management.

The disposal of waste pesticides will probably require the use of RCRA permitted facilities or a few other possible methods as discussed previously.

It does seem reasonable to dispose of empty pesticide containers using local systems if certain conditions can be met. These conditions must be such as to permit the ready verification that the containers are truly empty and the disposer must be prepared to pay the local system for any additional costs incurred. Individual generators and/or representative trade associations should initiate discussions with disposal site owners in order to implement such arrangements.

REFERENCES

1. Krueger, Raymond F., 1985. Federal Regulation of Pesticide Disposal. Proceedings of the National Workshop on Pesticide Waste Disposal. U. S. Environmental Protection Agency, EPA/600/9-85/030. p22.

STORAGE, HANDLING AND SHIPMENT OF PESTICIDE WASTE - REGULATORY REQUIREMENTS

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This presentation will address the storage and transportation aspects of proper waste pesticide management under Federal law. Topics include the identification and classification of waste pesticides, notification requirements, the pretransport requirements of storage, packaging, labeling, marking and placarding, the Uniform Hazardous Waste Manifest, recordkeeping, reporting and the farmer exemption. Under each topic, the waste pesticide generator's or transporter's requirements and the problems they may face in trying to comply with the regulations are discussed. Problem areas include waste determination, proper use of Department of Transportation nomenclature, compliance by small quantity generators, proper storage of waste pesticides, and compliance by commercial applicators.

Special focus is made on compliance with the new Uniform Manifest requirements and the impact of State laws on completion of this manifest.

Another area of focus is the RCRA reauthorization requirements for small quantity generators -- which includes waste pesticide generators.

National enforcement priorities and penalties are contained in the presentation. Although generators and transporters of hazardous waste account for the smallest percentage of EPA enforcement inspections, they represent a large national total. Additional enforcement inspections by other Federal agencies and state offices will augment the EPA program.

This presentation is aimed at pesticide users who generate or transport a hazardous waste and who must comply with Federal hazardous waste management standards. The purpose is to give these people a basic understanding of the regulatory requirements and enforcement ramifications.

TECHNOLOGY, REGULATORY, AND USERS' SUMMARY PANELS:
OPENING COMMENTS

Roy Detweiler, Workshop Chairman
Consultant, E.I. du Pont de Nemours & Co.

Thanks to Marilyn McKinnis of NAAA, Sherry Cramer of NACA and to the hotel staff and convention bureau here and especially to our twelve co-sponsoring organizations.

I am pleased with the workshop and I think I know how you feel because I have read all of the comments that were received and will give you some feedback on that in a moment.

Special mention needs to be given to Francis Mayo of EPA and Phil Kearney for handling the sessions yesterday and for the work they have done behind the scenes in putting this conference and the research conference together and to all who made presentations, to the exhibitors and to those who are joining us today to give their summaries as panelists who we will be hearing from. I want to thank them very much and if you do not mind join me in a round of applause.

My own assessment of the workshop was that it was well done and was another step toward providing useful, environmentally safe, and regulatory compliance, cost effective methods and procedures to the user community. But, and it is a big but, we have not yet achieved our goals. We have passed some milestones however, such as opening up communication channels between the users and the regulators, between the agencies; Department of Agriculture and EPA, and within the agencies; EPA's Office of Pesticide Programs, Solid Waste and Office of Research and Development. They are talking and making progress. And within the Department of Agriculture, the various sections and groups, sub-sets have been working on this issue and notably among the associations, with particular emphasis on NACA and NAAA. We have learned some ways on how to minimize waste generation by cost effective methods, apparatus and procedures, as described in the workshops yesterday, particularly in Illinois and Louisiana. We have heard discussions of new technology and demonstration projects sponsored by NACA that are coming close to being ready for use but not yet blessed by the regulators. We still have the problems of RCRA and state permitting with the intended time delays and costs. Although we have learned that the regulators have heard us and understand our needs. They are beginning to cut through the regulatory red tape and are trying to accommodate our pesticide users within the FIFRA and RCRA regulations. But sadly we do not have the answers to give you to take home with you today. I am convinced we will get them in the next year or maybe two, but we really cannot wait much longer than that.

I have been thinking about the workshop and have some suggestions. Some of them new, some of them old and I would just like to put them out here for consideration. I think class permitting is a need, so that a proven treatment method could be installed anywhere once it is approved by say a central Washington EPA group and make a simple application that would allow you to get a RCRA permit or a special exemption without going through the very time-consuming, expensive RCRA part B application. Another idea I had that maybe could be worked out is low cost government sponsored loans for the installation of such disposal technology for farmers, dealers, applicators and small users. Perhaps permitting accelerated depreciation allowances for these systems would also be useful.

Exemptions for installation of new systems to demonstrate new technologies that is cost effective and user friendly would be a good idea. Even if was just for a short time, to show and prove these methods, it would help improve the environment. One thing that is very important is to enter into negotiations between EPA, agriculture and user associations to get on with the regulatory process and move ahead.

Yesterday we asked for your opinions on a third conference, or a third national workshop. The results indicate that 94% of you supported, 4% are not in favor and 2% were unsure or said maybe. 86% say it should be held next year, 8% say in two years or when processes are proven and the programs are in place so that we have really something important to say. 88% say they would attend another conference.

Now over two-thirds of you made some comments and offered ideas for the next conference or for the future. A great number of different kinds of ideas and a great number of conflicting ones too. All were in favor of achieving prompt solutions to the pesticide and container disposal problems that would be cost effective, environmentally safe and user friendly. Many of you are impatient with the regulators and had some pointed suggestions to make including: do not invite them, too many lawyers, etc. But I have listed maybe ten key points that I have picked up from all of these comments.

1. Provide small quantity generator exemptions.

2. Resolve the conflict between states and EPA so that they provide consistent guidance.

3. Make rules simple to understand and follow.

4. We need educational programs for farmers, applicators and dealers on regulations and acceptable disposal.

5. We need a milk run for transportation of hazardous waste. Also information on who and where these wastes can be disposed of and the cost. And where the containers can go. Names, costs, information, etc.

6. The next conference should have a brainstorming session with representatives of various groups to develop regulator initiatives and goals.

7. Get the state groups to discuss their programs.

8. Survey attendees on current disposal activites, minimization techniques, what kinds of systems are acceptable and what their costs are. Make this information available through extension services and state and regulatory agencies.

9. Industry should assume a greater role in education: to educate applicators and users on ways to minimize waste and disposal of waste, and to pesticide applicators and registration certification.

10. Include programs for lawn services, household pesticides, tree services, and other users of pesticides rather than just the agricultural.

In summary, by and large, most of you liked the workshop, and the ideas you submitted will be considered by our coordinating committee; we have a meeting at 1:30 today to see what we want to do for the future.

We are going to keep you informed of future workshops and you will be receiving the proceedings of this workshop, hopefully in the next five or six months.

Now, on with the business. As you know we have had three groups of experts attending these sessions, paying close attention to what was said and to your questions and we are going to hear from them next. They represent technology, regulatory, and user groups and the first group we have at our table is the technical group.

TECHNOLOGY SUMMARY PANEL

James N. Seiber, Panel Chairman
University of California

Dr. Philip C. Kearney
Chief, Pesticide Degradation Laboratory
USDA, Beltsville, Maryland

Francis T. Mayo
Director, Water Engineering Research Laboratory
EPA, Cincinnati, Ohio

George P. Nassos
Director of Sales & Training, Ocean Combustion Services
Chemical Waste Management, Inc.

Jim Seiber:

Thank you very much Roy. First of all I would like to introduce my co-panelists, Dr. Phil Kearney, Chief of the Pesticide Degradation Lab at USDA in Beltsville, MD; Francis Mayo, Director, Water Engineering Research Lab, EPA Cincinnati; and George Nassos, Director of Sales and Training in the Ocean Combustion Services of Chemical Waste Management. We have a rather difficult task before us. We are going to attempt to summarize the technological aspects of the conference and particularly to look at where we have come since the last workshop. That is, what progress has been made and where we need to put our emphasis in the coming months.

As far as my own mood on the workshop goes, one of the attendees, Bob Fuget of DuPont, pretty much summarized what I had not been able to express in words. He said his impression from the conference was that people are "adapting." I thought that was a good way of putting it. He did not say that we have solved all of our problems, but implied that we are making steady progress. We said last year that solutions would not come overnight but we could expect progress to be made; I think that is what this workshop has shown us above all.

Surely we are recycling and conserving more. We are also seeing some field scale demonstration of success in technologies that were research curiosities just a few years ago -- things like carbon absorption treatment, UV ozonation and others. We are seeing the beginning of promise in the area of on-site cleanup.

I want to talk about the on-site cleanup now in my summary. This is a diffucult area. Maybe it is the toughest thing that we face in this overall problem of pesticide waste disposal.

First, we are trying to clean up sites where the waste was generated, in some cases many years ago; so we are thus facing the "toughest" chemicals, that is, those that last the longest.

Second, these wastes are spread out in the soil. They are not contained, they are not in tanks, we cannot physically manipulate them the way we can with liquid waste.

Third, the concentrations vary greatly in these cleanup challenges. We have seen results from our own work in Davis where a sample might yield 100 parts per million, while another two feet away might contain 5,000 parts per million.

Finally, we have a moving target as a goal. We do not know "how clean is clean." We will not know when we have succeeded in the cleanup operation. We must learn as we move forward.

There were three approaches to on-site treatment during the conference this week. One was to spread the soil on the surface and expose it to ultraviolet light and the possibility of volatilization. Ian Pepper of Arizona described this approach to us. A second approach that we heard about was microbiological. Let the microbes take care of it, either in their native state or perhaps facilitated in some way by amendment to the soil. Art Craigmill of UC-Davis described work going on there and again Ian Pepper described some approaches in Arizona on the biological treatment. The third area was chemical treatment. Tetra Tech described the use of sodium hydroxide in soil in one their poster displays. Another approach was given by Dr. Borrup of Tennessee Tech where he described the use of hydrogen peroxide which could be added to liquid or solid waste and, in the presence of a catalyst, would generate hydroxyl-radical, one of the best oxidizing agents known. I thought that was a very interesting approach and that his poster was very well done.
In all of these cases we saw the beginning of residue decline taking place in the results. We are talking about maybe 20 or 30 percent over six, seven or eight weeks, which does not seem very spectacular when you compare it with the UV ozonation where you get 99% decline in a few hours or a few minutes. I do not think we should get discouraged; we are really breaking some new ground here and that 20 or 30 percent in 6-8 weeks may be very significant in the long run.

I would like to share with you some problem areas and challenges I see with respect to on-site treatment.

First of all I think that we who are working in this area need to design our experiments in such a way that we get clear-cut analytical results. We saw a lot of scatter in the analytical data that was presented at this conference in the on-site treatment and decontamination area. This means we have got to go more to controlled, replicated tests using contaminants at known and uniform concentrations. It is tempting to go directly to the field and try to clean it up with chemical or biological agents. But in fact we must first do basic work in the laboratory with some controlled experiments.

Second, we need better and quicker ways to monitor our progress in addition to taking the samples and sending them to the analytical lab. We heard descriptions of some interesting trials, but the speakers told us they could not give us the results yet because the analysis was not done. We need to do a better job in that respect and Phil Kearney mentioned the use of immunoassays as an example of an on-site, quick type of analytical capability.

We saw immune systems being demonstrated in the poster area, including some tests that could be run quite quickly. I believe they said that in 90 seconds they could get analytical results. That was for water but maybe it could be adapted to soil in the future.

I think we may have overlooked another type of on-site evaluation, one that was not represented at all in our conference this week. That is the area of bioassay. Using inexpensive organisms like fruit flies, mosquito fish, and Daphnia. There are some big advantages to bioassay. They tell us the total toxic residue that is present. That is really what we are looking for, the parent and the breakdown products.
They tell us if we are making the kind of progress that is important. Are we really detoxifying the site? Only a bioassay can tell us that. Our chemical tests will tell us if the parent is going down, it will not necessarily tell us (unless we know what to look for) what toxic breakdown products are being formed. We need to do more in the bioassay area.

Third, we need to constantly watch out for this problem of forming secondary products are essentially are problems. I remind myself frequently and I will share this with you also, that any time you carry out chemical or biological degradation of organic molecules, the rule is that you create products that are more polar, more water soluble and thus more leachable. We certainly do not want to get in the position of cleaning up the parent compound but creating something that is going to cause us more problems and perhaps penetrate to greater depths.

All of these things do not mean that you should get discouraged about on-site treatment but rather that we need to take a broader look at all of the possibilities and be patient.

To summarize in the area of on-site treatment, I think progress is being made, we are "adapting," but there is still a lot to be done.

At this point I would like to turn it over to Dr. Kearney to bring us up to speed on physical and chemical treatment options.

Phil Kearney:

Thank you Jim. I want to tell you about a meeting I attended last week that reflects on what we are doing here. USDA had a big meeting in Atlanta, Georgia, and the issue we were talking about was groundwater pollution and what we are going to do. About forty scientists met there, and the problem is simple: we have got to keep pesticides out of groundwater. There is tremendous concern from the public sector that we be very careful here. It comes down to two issues: the issue of faulty waste disposal -- maybe that is not the right term, but what we are dealing with here -- and the non-point source; that is, the one to five pounds we use normally in agriculture to control pests.

We will put some resources into the disposal issue. I have been attending groundwater meetings for the last two years and our people seem to have a real grasp of the issue. It is complex, it is regulatory, it is science; it involves users and manufacturers. My recommendation is let us, the government, take our resources, what ever we have, and worry about the nonpoint issue. People sitting in this room have the best opportunity to focus on the disposal issue. They accepted that. ARS is going to make a strong commitment to groundwater research; it is going to be a high priority item. If we have to divert funds from other programs to keep this going then we are going to do it.

Let me discuss disposal technologies available to us in the areas of science. We have the possibility of reusing or recycling these compounds. To take the wastewater from one day's operation and use it as the diluent or the solvent or the mixing solution for the next day. The overall idea is that you really do not accumulate large volumes of a waste and therefore you do not have to treat it. I was rather impressed with this concept. We do not have to treat large volumes. We can probably do it economically, which is the key issue. The cost of these options must be considered in light of the current depressed farm economy. I was very encouraged about recycling, reuse, the use of concrete pads to contain this material. On Monday, however, I began to see the questions that came up from the audience about this disposal option. As a panel chairman I asked you to submit questions; I saw some disturbing things that worried me. There was a question about insurance. If you recycle maybe the insurance company may not cover you. Then a question arose about regulation, i.e., does all this reuse option fit into the regulatory pattern. There are some serious questions here. I talked with a young chemist; the thing that worried him was that there is no destruction going on out there. He is also worried about the fact that some of these highly active compounds are going to get on that pad, wash into the solution and are going to have a residue or phytoxic problem on the next spray operation.

We are having a revolution in chemistry in the area of pesticides. The compounds that we used twenty years ago are different from the ones we know today, and by the year 2000 we are going to have a whole series of new compounds that many of you do not recognize today. If you are selling these materials in stores, you begin to see the packages are changing. There are some fantastic new chemistry coming out and we are going to have to be careful not to mix these new chemicals. I was concerned about these questions, and that evening I had dinner with a lawyer friend of mine, and he related to me a problem we are having with recycling. The case involves a client being sued because the pesticide permeates down into that concrete pad and now this pad may be a toxic waste! The question is, do we take a jackhammer and break it up and haul it to a dump site. There are so many problems but few solutions. The next morning I heard Darryl Rester and A. G. Taylor talk and I was impressed with progress on recycling. I talked with them about the number of accidents that they encountered. Darryl has been recycling pesticides for several years. 1978 was probably when they first tried this method. So they have had 7 or 8 years of experience and they have had a minimal of problems. I am persuaded that we have a certain amount of risk here; but as Rester said, we can do two things. We can cope with it, that is to contain it and then work on it later; or we can continue doing what we are doing now and there are some serious problems. In some areas there is no attempt to contain it, there is no attempt to process it, and we would be far better off if we began to deal with the problem, that is to contain it, to catch them, and then to do something with it. I think that is the way to go. And it is a question of risk. Science is risk.

Let me share an anecdote about risk. At Georgia I had the great opportunity to meet the President of the University, an outstanding man, a true visionary. He said, let's talk about risk. The American people are not afraid of an automobile, they love an automobile but you look at the death record in this country, i.e., about 50,000 people die in this country due to automobile accidents. He said look at the cigarette.

America is not afraid of the cigarette. If you look at the death records about 100,000 die a year due to smoking. You know what the American people are terrified of? A shark! If you mention shark to a person they just freeze. He said, I went to the Coast Guard and to the Navy and I said to them, how many people a year die of sharks. Coast Guard says, we have no idea. If you say 2 you would be off by a factor of 100. He says, let me give you an example of what risk is about. If you go to a beach and stand on a high place and you holler shark, a thousand people rush out of the water, they run over to their car, close the windows and light a cigarette. I think that is a fair assessment of risk.

We have the question of what can we do once we have the pesticide wastewater contained in an area. We have a number of options open to us. We have charcoal absorption. That works. Now we can make it mobile and spread the cost out among the number of users, it is an option that is viable to us. We have the problem that some compounds are not absorbed and you have to do something with the carbon. You need to burn it or bury it in a safe place. We also have hydrolysis and if you know some of the chemistry of the pesticides we are using now it is viable. You can make it strongly acid or strongly basic and break many of these compounds. The only problem that worries me as a chemist, some of the worst accidents I have ever seen in the lab were with somebody working with hot acid or base. But we do not need to use a hot acid or base, we can use an enzyme. What an enzyme does is act as a catalyst. You heard Dr. Karns talk about biodegradation. We have large solutions of waste water that we put organisms in. Well what he is doing is hydrolizing that compound.

We talked about using UV-ozonation. Of course this is my pet project. It uses intense light and it uses oxygen that we breathe, and it puts it into a form that is a very useful catalyst. Some chemists are concerned about epoxide formation in these reactions. The thing that is saving in our situation is that we use a very large amount of water. Water interacts and the compounds we are seeing are really no different than the compounds we see from a microbial metabolism. We have yet to see anything new and very different in the chemistry of these reactions. We should push ahead with UV-ozonation but it means some industrial backing. There has to be a market for each of these technologies.

We talked about small scale incineration. Incineration, if we had endless dollars and resources, could solve the waste disposal problem tomorrow. You can burn pesticides, and that is the safest way to do it. Incinerators will burn these compounds for us and it will convert it to carbon dioxide and water. The problem is this can be costly and I think the large incinerator people do not want to deal with it. They do not want to deal with some farmers several gallons from Nebraska or Iowa or Kansas. They have other bigger problems with industrial waste. So we need to look at small scale incinerations. Can we make it feasible as a method to dispose of pesticides?

The other technology that is really experimental is the solar photo decomposition. You take a particle and it absorbs energy from the sunlight and it transfers that energy to a pesticide and destroys it. It sounds good, but we need more experimentation.

Pesticide wastewaters are difficult to treat. They are dirty, variable concentration and there are other things in there. I would like those people who are interested in this area to come join us in a very difficult area of chemistry. Where should we go from here? I am going to propose that we send you a questionnaire and ask you as a regulator, or as an industry person, or as a farmer user, these are the technologies we talked about; what is most applicable to you? What is applicable to you in California, what is applicable to you in Louisiana and in Maine. We can then begin to go forward and say to the regulators, this seems to be reasonable and let's proceed down this option. We will keep pressing science to get better answers for you. But I think indecision is getting us into more problems than a calculated risk. I think we had better take some calculated risks. Thank you.

Dr. Jim Seiber:

The next panelist is Francis Mayo, Director of EPA's Water Engineering Research Laboratory in Cincinnati, Ohio. He will summarize the biological aspects of waste treatment.

Francis Mayo:

I certainly concur with Phil Kearney's commentary on the need for recycling. These residues need to be reused to the maximum extent possible so that their treatment is kept to an absolute minimum. We should not be dealing with fairly large volumes of dilute waste if there is some other way to reuse and recycle that material.

When what needs to be treated has reached some minimum, it seems to me we have some fairly bright opportunities for biological treatment of those materials if we can resolve two or three key issues.

One is the concern for leakage or seepage from pit-type facilities into groundwater; perhaps these facilities could be placed above ground. With above-ground facilities, leakage could be positively observed, and criteria for constructing these facilities could reduce the risk associated with a structural failure to some acceptable level. If we can do that and if the regulatory process will accept that kind of a risk, then I think there are some opportunities for using biological mechanisms to degrade these waste materials. The pit offers some prospects for photodegradation and biodegradation to work in combination and provides the prospect for using media in the pits that would enhance the opportunities for biodegradation.

Another concern is the degradation products that are contained in these facilities. We may have a very long way to go before we understand all of the biological and chemical processes that are taking place in them. But if, in fact, the products are reasonably contained and there is a degree of integrity that satisfactorily reduces the risk of failure and if, in fact, the material is going to be degraded and there are no difficult-to-dipose-of residues, it may not be important in the short run that we know completely what processes are taking place. In the pit or tank-type operation and in an above-ground context, we can look at the work being done at the University of California, Davis, that Art Craigmill reported on. We can look at the acid and alkaline trickling-filter-type facilities at Southern Illinois University that Brian Klubek reported on, and certainly we ought to be very, very attentive to the commentary that Jeffrey Karns offered us yesterday about using engineered organisms or selectively propagated organisms to help foster the efficiency of biological processes in these kinds of facilities. We should all be aware of genetic engineering and those techniques of engineering organisms that may be usable or adaptable to the kinds of issues we are dealing with.

Reference has been made to the leach-field technology being used in the state of New York. Yesterday, I had an opportunity to talk yesterday with Betty Ann Hughes-Davis from the New York Department of Environmental Conservation. She indicated that those facilities are being given very serious reconsideration; that, in fact, they might not continue to be used in the New York; and that there certainly was a question about the viability of that approach on a broad base.

Evaporation and biological treatment with wicks, a very simple prospective technology that was illustrated yesterday, just begs for serious consideration. It can be very, very inexpensive, and it can be easy to operate. At the moment, however, no one seems to be giving it much play from a research standpoint.

I must tell you that, as far as the Environmental Protection Agency is concerned at the present time, the Office of Research and Development is making no contribution at all to research activities in these areas. What modest resources we have contributed to the meeting a year ago, to the workshop in July, and to this meeting today are funds that have been taken from other sources; they are not part of a deliberate pesticide disposal research program. There are no funds in the program for 1986. There are no funds presently planned for 1987, and in the absence of a willingness to reprogram some manpower and resources, the Agency is not going to be making a significant contribution to solving the kinds of problems that we have been discussing.

I think equally important with the viability of the technologies (in the context of our abilities to understand them at present) is the need for the regulators, both in EPA and at the state level, to give us some targets at which to shoot from an engineering standpoint. If we know what levels of concentrations will be acceptable or if we know, from the regulatory standpoint, what kinds of technologies might be amenable to class permitting, I am convinced there is an engineering capability to bring together these physical, chemical, and biological processes of understanding to solve these issues. From the standpoint of facility performance, however, it becomes very difficult to make judgments on costs and on the comparative effectiveness among competing technologies without some regulatory targets. So there is an urgent need on the regulatory side of the house to provide at least some preliminary targets against which we can seek engineering solutions. I hope this will take place in the near future in terms of the interaction between the Office of Solid Waste and the Office of Pesticide Programs, and I hope that they will be in a position to comment on that during the wrap-up remarks a little later this morning.

This is the extent of my comments. Thank you.

Dr. Jim Seiber:

Thank you Francis.

We are up here talking about physical treatment options, chemical treatment options, and biological treatment options. We need to realize, I believe, that the three approaches are compatible, and are not competing with each other. We could physically treat our waste streams to remove the worst factors, then soften the molecules that remain in that waste stream by chemical treatment, then we could let the microbes finish them off. I think these three fit together very nicely in a systems approach, which is what we should use if we are going to come up with the optimum system.

Jim Seiber:

Our last panelist is George Nassos, George is with Chemical Waste Management, Inc., Division of Waste Management. His job title is Director, Sales and Operations for Ocean Combustion Service -- North America. He is going to give us a perspective on commercial waste management options for our problems.

George Nassos:

You have heard in the last few days and this morning some of the possible disposal methods for pesticides that are in various stages of development. Today I would like to just briefly cover what is actually being done today and a little bit about some of the newer methods that are just coming into the commercial stage. Interspersed in my talk you will probably hear a few commercial messages, but that is something I have to do to justify my being here.

Current methods for handling dilute streams, basically what many of the companies do including Chemical Waste Management, is to take these dilute streams and put them in surface impoundments. We are not talking about any old surface impoundment; by law they must be double lined. What we mean by a double lined surface impoundment is a clay liner of about one to two feet thick under which is a synthetic liner which is your first liner. Beneath the synthetic liner will be a crushed aggregate that is used as a collection area in case you get any leakage through the first synthetic liner and underneath that another synthetic liner. Below there is anywhere from 50 to 600 feet of clay.

The material is then evaporated and the residue is stabilized usually using something like a kiln dust or the material can be treated biologically.

What do we do for concentrated streams? Concentrated streams are usually handled by incineration or if it is a sludge then it can be stabilized and landfilled. The incinerator streams are usually the organic ones, the aqueous streams are the ones that are ideal for stabilization. Solids like dusts and powders can either be landfilled or again incinerated. Some of the new and developing methods are all based on a concept where you first separate the toxic component from the solution media and the idea there is why treat gallons and gallons of water when a small portion is really the toxic component. What are some of the ways we can make these separations? The obvious one is evaporation, and if you are in an ideal climate where you get very little precipitation that is great, but if you are in another part of the country where it is not possible the only way you can evaporate is using some outside energy. A new way that is being developed and we hopefully will be offering it soon is freeze crystallization where you freeze the water and separate out the toxic components. The advantage of this is that the heat of crystallization is significantly less than the heat of vaporization so the amount of energy is considerably less. Also you do not have any air or water pollutants.

What are some of the treatments in disposal methods once you have made the separation? Well the obvious one, and Phil Kearney mentioned it earlier, is incineration. The disposal industry really believes that incineration is going to be the way to go. We are going to need more and more capacity in particular because of the RCRA 1984 amendments banning the landfill of many waste streams.

What kind of incineration capabilities are there? As you know, there are a lot of rotary kiln incinerators. They are large ones, as Phil mentioned. Chemical Waste Management has one in Chicago; Rollins, the competitor, has several; and there are a number of other smaller ones. Another possibility -- and we hope will be a reality very soon -- is ocean incineration. That is what I have been working on for a number of years.

Chemical Waste Management has the Vulcanus vessel; it is in the process now of obtaining a permit to do a research burn sometime this spring, and hopefully that will lead to an operating permit early 1987.

What about other incineration or thermal destruction options? A French company is trying to bring a process called the Vicarb process, which is a high dispersion incinerator that shears the droplets as they pass through a venturi. They claim that they can get the destruction efficiency of six or seven nine's within a very short distance. Other techniques, possibilities, is plasma arc pyrolysis, another incineration method that is being developed by Chemical Waste Management and a company called Arc Technologies. This is a system that operates in the plasma zone 11,000 degrees farenheit and in the furnace chamber at 3,000 degrees farenheit. The advantages are that the gases to be scrubbed are very minimal. Again, this is to be used primarily for solids like dusts and powders. Westinghouse has a plasma arc which is a mobile unit and it is all enclosed in a 45 foot trailer. Presently available, it can handle waste streams at a capacity of about 6 gallons a minute. Not really large but perhaps something that can be used for the small generators.

You have heard today and on Monday about activated carbon treatments. This is not something in the experimental stage it is available today and again Chemical Waste Management has a mobile unit that is presently being used for cleaning up surface impoundments where we pass the material, waste, through a sand bed filter and through the activated carbon system. Other companies, I am sure, are also developing that and have it available.

Another option is wet air oxidation. This is a process that has been developed by Zimpro and is again offered commercially. It oxidizes the waste at very high pressures.

All these systems are well and good. The question is, how do you get your waste to these systems to get it processed? There is a need to handle the small generator and many companies are trying to develop a system for that. Again, being that I know more about Chemical Waste Management than any other company let me tell you what we are doing.

Our company has nine treatment facilities throughout the country, which may not be very close to any of you. However, we also work with Ashland Chemical Company that has about sixty terminals throughout the country. What Ashland does is pick up one drum, two drums from the small generators, collects a sufficient quantity to bring a truck load to one of our nine facilities. Granted, Ashland is primarily in industrial areas and not in the heart of the farmland of the US and they may not be convenient to you. The only thing I can say about that is as a result of this workshop I will be going back to our management, to our planning and development department, and bring this problem to them and hopefully we can come up with a solution that could help you and hopefully present it to you next year. Thank you.

QUESTIONS AND ANSWERS

Roy Detweiler:

I was surprised to hear George give information on the competitors.

If anyone has some interest in the Westinghouse project I am familiar with that, I am a consultant to them. That is my plug.

QUESTION for Francis Mayo:

It would be very helpful to have data on pesticide degradation and activated sewage processes. Does any such data exist?

ANSWER:

Yes we do have some information because for the last six or seven years we have been looking at the fate of priority pollutants in municipal wastewater treatment systems. We have a pretty good idea about how the conservative ones move through the system and how those that are susceptible to biological degradation are affected by wastewater treatment. We do have some background on the behavior of some of these materials in municipal wastewater systems in terms of what percentage may go into sludge, what portion may be stripped as a consequence of the aeration process, and perhaps what portion of it might actually be biodegraded. We don't see, however, at least not at the moment, the likelihood that these systems are going to be a major receptor of these materials, particularly those that are conservative and move through the system.

QUESTION for George Nassos:

Why is the ocean such a highly desired place to do the burning? Isn't the risk to the sea a serious potential?

ANSWER:

There are a couple of major advantages of ocean incineration. One is the capacity of an ocean incineration vessel relative to a land based incinerator. The reason for this is that ocean incineration does not require scrubbers. Land based incinerators are constrained by the throughput of the scrubber. The exhaust gases of an ocean incineration system are basically carbon dioxide, excess oxygen, traces of carbon monoxide and hydrogen chloride gas which falls into the sea water and is neutralized by the natural alkalinity of the sea. As a result the capacity of a vessel roughly three to five times that of the largest commercial land based incinerators. Regarding the question of risk to the ocean, there is a risk no matter what you do as mentioned earlier. Our vessel has been operating in Europe since 1972 without a single incident of accident or spill. The ship is especially built, it is one of the finest constructed vessels in the world with redundant safety systems with respect to any emissions coming out. In numerous tests the ship has demonstrated destruction efficiencies of greater than 99.9999%. We are not sure how much greater because nothing has ever been detected coming out of the stack. To put it in perspective, if the ship were operating full-time in the North Atlantic, we are talking 18 burns a year at 800,000 gallons and if it were all PCB's and we only achieved 99.9999% we would dump about 41 pounds of PCB in the ocean per year out of the stack. Compare that to about 12,000 pounds of PCB's that go out into Chesapeake Bay every year from groundwater, through the estuaries. So the risk is really insignificant.

QUESTION for Francis Mayo:

What is the wick material that you referred to?

ANSWER:

We do not have any samples of it. Bob Claunch is the one who has proposed this. He believes he has a wick material that would accelerate the movement of the dilute waste material out of that central trough up into the wick for evaporation and, prospectively, photodegradation and biodegradation. It seems to me that there may be a variety of materials that could be used. It may even be possible to incorporate some materials into that wick (just by weaving it into whatever is used for a wick) that would foster photodegradation. There are opportunities here that warrant looking at.

COMMENT for Phil Kearney:

This is a comment referred to Phil. The U.S. Army is using carbon absorption to remove pesticides from equipment wastewaters. EP toxicity tests indicate that the pesticide cannot be leaked from the carbon therefore, the state of Virginia that the pesticide contaminated carbon is not a hazardous waste and has authorized the Army installations to bury the carbon in a sanitary landfill. Do you have any comments on that?

RESPONSE:

That is good, if that sanitary landfill will be available in the future.

INFORMATION REQUEST:

Here is a commercial message. Somebody wants some information on Ashland Chemical, where they can be contacted. Information will be given later rather than make an announcement here.

QUESTION for Roy Detweiler:

It says commercialization of waste minimization or disposal is essential for major improvements and their uses. What will be done in future workshops to obtain participation of all manufacturing elements who need to be encourage to join the team?

ANSWER:

That is fairly simple to do. Through NACA we can get others in here to discuss it if there is such a need and that will certainly be referred to our committee who will be meeting this afternoon.

If there are no further questions, I would like to thank the panel for their work.

REGULATORY SUMMARY PANEL

Raymond F. Krueger, Panel Chairman
Office of Pesticide Programs
US EPA, Washington, DC

Orlo Robert Ehart
Executive Assistant, Wisconsin Department of
Agriculture, Trade and Consumer Protection

H. F. "Butch" Calhoun III
Director of Pesticides and Environmental Programs
Louisiana Department of Agriculture

Roy Detweiler:

The group we have assembled here is called the Regulatory Summary Panel with Ray Krueger as Chairman. Bob Ehart is an executive assistant of the Wisconsin Department of Agriculture Trade and Consumer Protection, his job responsibilities include: policy implementation and formulation of environmentally related programs affecting agriculture, he is chairman of the SFIREG Ground Water Protection and Pesticide Waste Disposal Committee, and he has eight years of experience as Director of the Wisconsin Pesticide Control Program. H.F. "Butch" Calhoun III is from the Louisiana Department of Agriculture where he is Director of Pesticides and Environmental Programs, his job responsibilities include: licensing and certification of applicators, dealers, consultants; he looks into damage complaints, enforcement of state and federal laws, waiver of use of restricted pesticides, equipment inspection, sampling pesticides, registration of pesticides, and regulation of pesticide waste.

Ray Krueger:

Thank you Roy.

I have been working with pesticide disposal with EPA for about 12 years and the interest and devotion to getting problems solved shown in this workshop and in the previous one is extremely gratifying to me. I think for the first time in the 12 years I have been involved in it we stand to make some progress, real progress. But what this means is that the pesticide users are not faced with just the regulations or the laws that EPA administers, specifically the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). The user is faced with a number of other federal rules under Resource Conservation Recovery ACT (RCRA), CERCLA, generally known as superfund, DOT regulations if you are going to ship anything and the aerial applicators are looking at the FAA rules that they have to observe. Beyond all that come the state regulations which supercede what the federal government has to offer particularly in FIFRA and RCRA.

I see a need for better adaptation of these rules because most of them, particularly the RCRA rules, were designed to deal with different problems than we have had as pesticide users. FIFRA is designed to deal with the use of pesticides, registering them for specific crop uses and really does not have the authority to control disposal, per se, although within our regulations we have already identified disposal as a use action. In other words our regulations are set up that way.

In the short term, as I indicated in my talk the other day, I believe we can put out recommended procedures to cover some items. The problem of disposal when we talk pesticides, we are talking everything from sulphur to household use products. The variety of chemicals is just astounding. In these recommended procedures we will probably take a very short step in terms of the long walk toward solving all the disposal problems. They will have to be equivalent, as it were, to the RCRA control. They will have to provide protection to human health and the environment in the same fashion that could be expected from RCRA regulations.

In the long term I see us moving toward custom made label statements, as it were. Each product will have with it information as to exactly how to dispose of that particular product and the residuals that may result from its use. Empty containers for example.

The problem with this approach as I see it is the variations in regional uses. We saw this with the use of evaporation ponds when they were legal. They worked just fine in places like Texas and California but they do not work too well where the rainfall is particularly high or in places like South Dakota where everything freezes solid. It may be difficult to tailor label statements to the broad uses of some products. Some products are quite regional so it would not be difficult there.

I can virtually guarantee you that the dialogue that has been mentioned several times at this conference between the Office of Solid Waste and the Office of Pesticide will continue. Our respective chiefs are very interested in this problem and extremely interested in getting something done. The priorities are there and you can expect that we will do something in the very near future.

We will need a lot of help from the users the state regulatory people and others in the broad spectrum that has been represented here at this meeting. We look forward to hearing from them.

One more comment. We will publish in the proceedings, and there will be proceedings published as a result of this workshop, the E and F lists that you have heard so much about over the past couple of days. Jean Frame has developed those, we have them, the pesticides that are on the E and F lists, I should say. They will be available in the proceediings. Thank you.

Remember we will accept questions, we have some time, so I would like you to think about that and maybe pose some tough ones to EPA. In the comments that I read last night, these guys dodge most of the issues, here is your time, I am going to put it to them and I will not let them dodge it. So if you have a question put it down.

Butch Calhoun:

Goodmorning. The problems I see with pesticide waste is that it is a national problem affecting the entire U.S. But there is no one national solution to the problem. The problem must be addressed on a regional basis and a state-by-state basis. We have not solved problems such as insects, weeds or diseases on a national basis and we have not solved problems with our certification and enforcement programs under FIFRA on a national basis. But we have solved these problems on a region by region basis and on a state-by-state basis.

Here is how we handle things in Louisiana. In most states, the departments of environmental quality or health regulate pesticide waste. But in Louisiana, the Department of Agriculture decided back in 1981 that we were going to handle pesticide waste. We assumed that no applicator could afford to be a generator of hazardous waste under RCRA and stay in business. We spent a lot of time trying to find loopholes in RCRA that would save the commercial applicator. After this great length of time we were unable to find these loopholes, so we decided that the only way for us to handle the problem was to keep the applicator from becoming a generator of hazardous waste. If you do not generate a hazardous waste you do not have to worry about RCRA. We also decided that with the possibility of the E and F lists changing from time to time, that the best way to approach this problem was to deal with pesticide waste. Do not worry about whether the waste is on the E or F list -- do not generate pesticide waste and you do't have to worry about what list it is on.

We took a chance on a piece of state legislation that moved the control of pesticide waste from the state Department of Environmental Quality to Louisiana Department of Agriculture. Now some four years later, pesticide users, pesticide dealers, manufacturers, landfill operators and regulators in the state agree that this move was worthwhile.

I personally feel that the state agencies that have been regulating the pesticide applicators under FIFRA should regulate pesticides from cradle to grave. We are the people who know the problems. We are the people who have the expertise. So why shouldn't we handle the problems of pesticide waste?

In Louisiana our pesticide waste regulations cover the pest control operators, aerial applicators and ground applicators.

Farmers are the only pesticide users that are exempt. I do not totally agree with this. Personally, I feel that if a pesticide used by a commerical applicator can cause a problem to our environment, then that same pesticide waste produced by a farmer can cause a problem. Our regulations are directed to commercial applicators in the handling of rinsate, washwater, and container disposal. When the laws took effect, the users were given three years to clean up sites and stop generating waste. On January 1, 1985 the Department of Agriculture began inspecting sites, issuing compliance orders, and bringing charges against violators. Since then some 200 aerial applicators, 200 ground applicators and 1,000 pest control operators have been inspected. To this date we have issued some 51 enforcement actions.

Container disposal has posed a special problem for us because many landfill operators have refused to accept triple-rinsed crushed containers. In response we have worked with the landfill operators on a one-to-one basis, explaining the disposal laws and seeking their cooperation. As a result, most landfill operators have agreed to accept these containers, thus giving us another victory.

I feel that in Louisiana we may be a couple years ahead of most states in handling our pesticide waste problems and I know the efforts of the Department of Agriculture, the Extension Service, with people like Darryl Rester, the pesticide manufacturers and the pesticide users, that we are several years ahead of most states on attitude. I feel that this meeting is a positive step in the right direction.

In closing I would like to recommend that we do the research in pesticide waste. Let's collect the data and let's get moving in the right direction.

Bob Ehart:

The requests of the most repetition of last year's talk, or the things which I spoke of last year are three things. Since I have been asked them repeatedly, just to make sure that nobody else in the audience is confused about some of the terms that I used last year, there are a number of acronyms. Bureaucrats all like acronyms anyway, but there are two acronyms that are in one of my papers. One of them is NIMBY, that is Not In My Back Yard, and LULU, and LULU is the one that sent everyone into a lulu, they cannot seem to remember that one. That is Locally Unacceptable Land Use, and it is something we spend a great deal of time trying to figure out how we are going to take care of a lot of our difficulties because of the locally unacceptable nature of things. It is always fine if it is someplace else.

The other issue was a lady by the name of Esther Foster. Esther is a lady who was living in a older style home, kind of a Cape Cod design and she has her hair all pulled back in a bun and is really an elderly type figure with a shawl around her shoulders, and a woven rug on the floor. The caption underneath this cartoon says that Esther Foster has not turned on the radio since she learned that they can broadcast herbicides. I think that does, in many ways, point to the nature of the concerns that many people have, that there are differences between real and imaginative problems. That is something that we are still having to wrestle with. What is the difference between the real and imaginative problems that we actually have.

Last year I ended a talk by giving a charge to the pesticide user industry that the destiny of their problems was in their own hands. I think that is still the case and I think the reason that we are having this conference this year is because they are taking the destiny of their concerns about pesticide disposal into their own hands.

I think that the communication aspects that were so desperately needed have been definitely fostered with the amount of efforts that have gone on in this last year and that is not only limited to the conference, it is also the amount of contact that there has been between people as a result of the conference, the number of people who know who each other are as a result of the conference. They are sharing a lot of the similarities that they have in things. I think there is much more of a communication level between researchers, which had come to pretty much of a halt, in the meantime, on disposal issues they were really not having the forums in which to communicate with one another, there has been a research conference and there is a lot more attention paid to pesticide disposal, considering what there was before.

There has been a clear indication by the headquarters people from EPA, they are showing us recognition. Recognition that their purpose is to protect the environment rather than to create infallible regulatory systems. That is a very significant issue. It is something that before got lost in the quagmire of regulations that we are able to produce. That also applies to us at the state level as well. A comment in the proceedings last year was a statement: problems for the pesticide users have not been solved as a result of this conference, the lines have just been better defined. That statement can again be repeated this year. The end user maybe has a few more things that they can do in order to comply, but there really has not yet been the problem solving nature, but we are a heck of a lot further along this year than last year. That is a very important situation.

A good way to look at what our responsibilities as regulatory people are is to look at what kind of challenges we gave each other last year and see how well we have done in those particular areas. For one thing we said there was a need to focus on the typical questions, concerns and issues in the area of pesticide waste. One of those things is to accumulate that kind of information. One of the efforts we have made through the SFIREG committee is to come up with a list of questions that are typically asked, that are typical kinds of concerns that need to be answered. EPA on the other hand, said once they have those kinds of questions, they will publish a questions answer sheet to address a lot of those issues. Questions are rather long and detailed, they would go into very specific concerns on those particular questions because that is where most peoples' problems lie. They are not the simple little short answers, short questions, type of things. They are very complicated, and they are complicated for a number of reasons. I think that is quite an important aspect. I gave a challenge to those of us in the states to become the one stop shopping center for information on regulatory programs which affect the ag industries. I went through the list, I may be off a little bit on these figures, last years proceedings and there were 28 state representatives present, and if I am not mistaken, I may have missed one or two this year, there are 17 or 18 states that are here this year. At least 10 states have already taken care of all those problems and did not need to come back. Actually that is fairly facetious on my part, but it is something that I think there has been quite a bit of progress on and there is a lot more availability of information even though I do not think that we have gone to the fullest extent of becoming the center of knowledge on state programs that we need to and so I can yet again issue that particular need for us to become very intimately aware of the concerns that there are in pesticide disposal and become at least the focal point, if not the experts, on how to deal with those particular problem areas.

Another challenge in the discussion of uniform standards through pesticide waste treatment and disposal and also combining with that the designation of what kind of waste is actually on the label. I have heard more comments, particularly on the aspect of uniform standards for pesticide waste treatment and disposal at this conference than I had ever anticipated. I think it is something of an admission that because of the fact that what is legal today may be illegal tomorrow that we need to have concerns for liabilities for the future. We are all accepting the fact that we need to move directly into that area and to take care of our problems so that we do not have an impact on the future. That is one of the things that you will see, that we know that we have to pay more attention to and that you will see a lot more activity on in the future.

I am still concerned about where we are with labeling and I think we will see some directional changes in that area as well. It seems to be that we have to have a policy of truth in advertising. We pure and simply have to put on the label so the end user knows what he has to do with it. If it says it is an E listed product or an F listed product or one that may qualify under EP toxicity, then the end user has some ability to know what in the world he is supposed to do. Until we get to that point we are putting it in CFR's that nobody can read, is absolutely unacceptable if we are really expecting to have compliance. And I think we as regulators have a challenge in front of us to establish that kind of protocol if indeed we are going see future successes.

There were a couple of other things that we talked about last year in the protocol, building fires in abandoned sites, there has been some attention to that, these are local issues and need to be handled on the localized basis. We talked about designating systems as major regional and onsite facilities, making categorization of them and there has definitely been some in that area as well. We still need to look at regional treatment center and that type of thing if we are going to see the solving of a lot of the waste problems.

I think that the emphasis that we have heard at this conference has been one of do not become a generator, use up the materials as they are intended, and the waste problems are diminished is probably the major issue that we need to recognize in the fact that if we limit the amount of the things we are producing in that particular vein, a lot of our problems will be taken care of. It is something that all of us need to go home with. The idea of recycling, the idea of minimization as we look at all of these particular areas.

I also gave a challenge to the fact that the efforts were needed in research. Particularly the emphasis in regulatory questions needing answers, I was obviously elated to hear Francis Mayo say this is one of the things we need to pay attention to which they need from us. The pesticide users and research community of the world can have some kind of list of what our priorities are. If indeed we are going to change our mind about what the priorities are we need to be held accountable for those particular problems if we are actually going to solve them.

We are now seeing that creative genius switch into the research court, where I personally believe is where it belongs. Last year I accused the experts of taking a sabatical and not actually dealing with the issues that were before them. I think that we can definitely welcome them back.

As most people when they come back from a sabatical, I think they have come back with renewed enthusiasm. I think we still have a major role, all of us, in education. What is going on right now needs to be translated into what is useable and how it will actually impact all of us.

I think last year I labeled after the conference anyway, I labeled the group of us, us regulatory people, the ones that you are going to get to take a shot at here in a moment, as the unmoveable group of people. We are hard nosed, we talked about if you do not comply, you are out of business, it is just tough luck.

I do not think you heard that tone from a regulatory portion of this conference at all. I think that you saw a lot of movement in the fact that there are policy changes that can actually occur in these particular areas.

This year we brought in some RCRA area regional people, I heard a much harder line. Similar to what I think we heard from the headquarters people last year, and from FIFRA.

We also brought in the container people this year, they are new to this conference, and I also saw them as rather taking the approach of the unmoveables. I think next year we need to bring in the insurance industry or next conference, the insurance industry and more of the state RCRA people. The state RCRA people that are here, I think, are on the cutting edge of recognizing of how to actually go about things. But I am not convinced that those that are not here share that same particular area. Often times it seems like the RCRA states people, because of the push from headquarters, interpret equal programs as identical. And I think we need to see a switch in that particular area, away from being identical to having more flexibility and that comparable is equal. The movement of some of the administration of those particular programs, to FIFRA to programs where in states that can be worked out, I think would be a step in the right direction.

As Butch has said, I think we need to look at management of the problem as a way that we actually treat it rather than the situation of really being more like ostriches and hoping it will go away.

I think there is a challenge for all of us regulatory people to recognize as we formulate our policies that people are part of the environment. And that we are going to have effects. But we are also the ones that have the intelligence to be able to work out the minimization of those affects. One of the things that there might be a need for us to look at is the fact that we heard that what might work in one state, might not work in another. That maybe part of the challenge is now to look at regionalization of these kinds of efforts. So that we look at similar problems that we have with the states that surround us rather than looking at trying to find a locally or an acceptable area for a national meeting.

Part of the reason, I am sure, that ten states people are not here, that maybe were last year, is pure and simply, budgets, difficulty in justifying travel, and that type of thing. Not lack of interest. And with that situation there maybe is a challenge for us to look at some kind of regionalization of the programs as we go down the road.

I think there is ample opportunity for all of us to work together and is something that would be a highly successful part of our program as we look at what we actually can accomplish in this area.

QUESTIONS AND ANSWERS

COMMENT:

It is hard to believe that OPP and OSW have much concern about this issue when as Mayo said OSW is not willing to spend any money on it.

QUESTION for Bob Ehart:

There seems to be a great deal of confusion about land disposal of pesticide wastes. Are you saying that both landfilling and landspreading are practices that will eventually be illegal?

ANSWER:

I think EPA might be saying that. That is an issue that we have been working on for some time with Matt Straus and his group. Matt is actually the person that should be asked that question. His answer has traditionally been that congress in the 1984 amendments suggested that they look very seriously at that and the implication is towards actually eliminating it. However, Matt generally stops short of saying that is a demand and therefore there may be some opportunity for those types of things. But I think the general tone of things is such that we should be looking at other methods of disposal, if at all practical and possible, but not necessarily that it will be totally eliminated.

QUESTION for Ray Krueger:

We have heard again this week of the inappropriateness of RCRA for the regulation of low-concentration pesticide wastes. NACA is promoting regulations under FIFRA, Louisiana has been successful in regulation without RCRA. When can we expect to see similar thought or action between OSW and OPP?

ANSWER:

The answer to that is in the very near future. But as in the case of all complex problems, we are going to have to deal with it a little at a time. The first things we can address, I believe, are the low-level dilute solutions from equipment wash, container rinse, and so forth, because they are at a much lower level than application rates. The problem is we do not really know what those levels are and we do not have a good enough handle on them to be able to address them intelligently. That is one of the first things we are going to try to do. Is to pull those numbers together as best we can.

I would like to point out that virtually all the work will have to be done within the Office of Pesticides or utilizing whatever outside help we can get from NACA or other user groups. Because the Office of Solid Waste are burdened with congressional deadlines that you would not believe. They have a great deal of regulation writing and modifications to do and they have very tight deadlines to get them accomplished. The 1984 amendments to RCRA that were mentioned before, for example, carry a dispensation from the normal regulatory procedures act. In other words, when we, EPA, write a regulation, the first thing we do before it is published, we publish it as a proposal and we look for public comments. We have public meetings and all kinds of things to involve the regulated community. The 1984 amendments excuse the agency from having to do that. Those regulations, for the most part can be put on the street without any public comment. The agency is doing its best to involve the public on that.

What I am saying is we cannot expect much help from the Office of Solid Waste, other than working with us, approving or disapproving what we propose and that sort of thing. We are going to have to do it inhouse.

QUESTION for Ray Krueger:

Can the FIFRA amendment be a practical solution at this time to get transferred the authority from RCRA to FIFRA over pesticides?

ANSWER:

Well there would not be what I would call a transfer of authority in any event. To answer that question, I would say no. Because the authority to regulate the use of pesticides is already available in FIFRA. The only thing we would do having equivalent rules in effect under FIFRA label statements or recommended procedures, would be to de-regulate those specific wastes from the RCRA lists or from RCRA control.

QUESTION for Ray Krueger:

This is a question that should have been referred to Straus. And I will give you the opportunity to say you do not know.

What is the status of RCRA as to when the law comes into effect? Becomes law as it might impact on the pesticide waste?

ANSWER:

Well there are so many rules that are being revised or written. Small quantity generatory regulations for example, that it is hard to say yes or no to that question.

Did you have any key dates in mind?

No I really do not.

QUESTION for Butch Calhoun:

Two questions having to do with the enforcement action you have taken. They want to know the nature of the violations, what actions you took and was that an effective way to get compliance? Can you comment on that?

ANSWER:

We have issued more compliance orders than we have actually brought charges. We expect that we will have more charges brought this year. We have a unique situation because we do have, under state law, the authority to impose a maximum fine of $25,000 per violation, dealing with the pesticide waste. We have one case where there was some improper disposal of container and chemical. The violator was charged $1,000 and required to clean up his problem.

So you just had one fine paid?

So far. Yes.

QUESTION for Butch Calhoun:

How did Louisiana handle old container dump sites?

ANSWER:

We had several different situations that we dealt with. Not all of them were dump sites necessarily and we have a big problem still with some old sites where we have some obsolete chemicals. We have handled each site on a case by case basis. We have had some sites which had to be cleaned up and hauled to permitted hazardous waste facilities. We initiated some research through the University, we had some sites that we cleaned the sites up and land farmed the contaminated soil on a piece of state property and we are monitoring it from year to year. Taking samples and checking to see if the chemicals are breaking down and at what rate are they breaking down. So we have basically just handled these on a case by case basis.

QUESTION for Ray Krueger:

Can the EPA declare and announce that spent activated carbon containing pesticides is not a hazardous waste and may be discarded in a local landfill now? Or is further data required?

ANSWER:

Given the data to show that that particular material was not a hazardous waste. That is to say EP toxicity test results or something on that order, the EPA could very well say that. But the final authority still rests with the state agencies that regulate the landfills and also given the fact of the emotional value of the word pesticide, it may be difficult.

QUESTION for Roy Detweiler:

Will submitted answers and questions and answers be published in the proceedings? As you have noted many questions have been submitted but time permits only a few answers.

ANSWER:

We will discuss that in our meeting this afternoon and see what we can do about that.

QUESTION for all panel members:

The idea of the state lead agency controlling FIFRA and RCRA program is good. Do you think that this is possible under federal EPA?

ANSWER - Bob Ehart:

If you had asked me that last year, I would have probably said no. I have a lot more belief that that is possible this year. There has been a lot of activity, a lot of discussion as to how would you go about doing that. Clearly a response from the RCRA people that if a proposal under FIFRA has comparable, not equal, but comparable capability of regulation that they see no problem with that. It is something that can be handled adminsitratively. And EPA has tended in the last several years, to look a lot more at administratively handling problems rather than going to congress to try to solve dilemmas. For that reason, I think there is a good potential, if indeed, we as state people can come up with that kind of activity. Our SFIREG committee will be wrestling with what we think might be some legitimate ways of dealing with that particular thing and looking at the kind of options that states do have. The experience that Butch Calhoun has had in Louisiana is somewhat of a model for us to look at and show the success that can be done in those particular areas. That comparable can be an equal type of a program. Therefore something of where EPA can look at that and say, yes indeed it can work, we would be willing for that particular area. I think Butch's experience also indicates that it administratively can already be handled with existing authority and therefore is something that makes it more obtainable as well.

ANSWER - Butch Calhoun:

To address our situation in Louisiana. Our Department of Environmental Quality was a state lead agency for RCRA. We worked a deal with them after we passed our pesticide waste law that when they went for final authorization under RCRA they made us a part of their package that they submitted to EPA. Thus when EPA approved them receiving final authorization they approved us receiving the pesticide waste end of it. We received a grant from EPA just like the Department of Environmental Quality does. It has been a very good marriage in Louisiana and has worked very well.

ANSWER - Ray Krueger:

I would like to add a little bit more to that. Given the long term possibilty of having tailor made disposal statements with each product, it would be very difficult for the states to do something different. Also, our recommended procedures, tend to set the tone of regulation in the states. They look to the federal government for guidance in a lot of these areas and I think what we will probably see is local modification to meet local needs.

COMMENT:

This is along the lines of developing one set of regulations on pesticide waste disposal that would be appropriate for the federal EPA to apply across the country. In all states it would be mandatory to treat to that level. That would minimize confusion and would make it easy for all applicators everywhere to be able to plan for waste disposal. Do you have any comments on that, any of you?

RESPONSE - Ray Krueger

I agree. But unfortunately that is not the real world.

QUESTION:

Can you expand on that?

ANSWER:

Well we already said that the problems of regulating from Washington are immense in terms of the regional differences across the country. Within states and within various parts of states. So that an even handed, across the board regulation covering all of pesticde disposal problems would be very very difficult. It may be possible to regulate say empty containers in that fashion. But I see that as a dream almost.

QUESTION for Ray Krueger:

Do you know what level of breakdown will be allowed for pesticides as a goal to work for? How close to zero?

ANSWER - Ray Krueger:

How safe is safe? That would probably be arrived at on a chemical by chemical basis, the only way I could see doing that. Which is what Matt said he was working on. At least as it pertains to groundwater.

Do you have a comment Orlo?

ANSWER - Bob Ehart:

Yes. I think that one of the things that we need to recognize, and that question raises it again, is that the answer to the pesticide users problem is minimization of the waste in itself. I do not think we are going to see any changes in RCRA philosophy or in handling of waste itself to move away from a zero tolerance. Butch just said to me, what is the definition of zero? It keeps seemingly to get smaller.

We have to recognize that and I am not sure we are going to see standards set that allows us to do that. I do think we may see some standards as to what is allowable in mixing pesticides that you spray out onto the fields that may worry the manufacturing industry as to what are their liability concerns or what kind of cases might be resulting from that. I see more opportunity for movement in that area than I do in the disposal end. I think the thing comes down to minimizing it as not a waste in the first place.

QUESTION for Ray Krueger:

We are in the lawn care industry. Please confirm or correct my understanding with regard to small generators. We need to collect recycled rinsewater and/or washwater that contains listed E and F pesticides. If there is more than two hundred and twenty pounds per month of sediment collected in our recycling system, then we are generators. If less than two hundred and twenty pounds a month, we are exempt and sediment can be disposed of in a dumpster. Is that correct?

ANSWER - Ray Krueger:

I am a little bit confused by the question. Sounds to me like the person asking that question is collecting the rinsewater for reuse. If that is so then it is not waste.

Then he is saying that the sediment that is leftover is what he is concerned about. If it is less than one hundred kilograms a month he is not a small generator.

Well if it is an F listed waste, one hundred kilograms would apply. But if it is an E listed waste one kilogram would be the minimum.

ANSWER - Butch Calhoun:

If he is doing the proper job of recycling this you will not have any sediment. If you do not store it for long periods of time, if you go ahead and reuse it, you will not have any sediment. And also, I would like to point out that different states have their own levels as to what is required on the E and F lists. For instance in Louisiana under our environmental quality law we have a zero tolerance.

QUESTION from Roy Detweiler:

Are you saying you could put the sediment back in and just spray it on?

ANSWER - Butch Calhoun:

You should not have a sediment. If you reuse the washwater within a reasonable length of time there will not be any sediment in the tank.

QUESTION from Roy Detweiler:

You think that would depend upon what the nature of the chemicals are.

ANSWER - Butch Calhoun:

Yes, but then all you have to do is wash the container out and take that washwater and use it. We have not experienced any problems with this in a year's use with all of our applicators.

ANSWER - Bob Ehart:

In the interest of making sure that we do not get by without answering everything, I think that there is another part to that question on "can I put it in the dumpster". I think you better check with your state disposal people as to whether they will authorize that. And you also better be careful from the standpoint of the landfill that it is going to have the right regardless of RCRA regulations to decide that they are not going to allow for that or the transporter to make you manifest it regardless of whether you have enough waste or not. It is something of where the transporting industry is often times a lot harder on waste generators than what the RCRA regulations are in order to make sure that they stay as low on the liability scale as possible. That portion of the question to be addressed to the fact that yes some states may allow you to do that while others would not do it for the moment.

QUESTION:

We have heard lots of good information on costs of treatment options. Please comment on the impact of costs of obtaining RCRA permits to conduct a treatment. Address especially cost impacts on small applicator operations.

ANSWER - Ray Krueger:

That is a little out of my field because I am not involved in permitting but the costs of those things are largely dictated by two things. One is the preparation of the necessary documents to apply for a permit and in some cases that can be quite tedious. And the cost of permit application levied by the state. It would vary from location to location and permit to permit.

The label improvement program of OPP provides for specific disposal instruction on containers for toxicity categories one, two and three. Any plans in EPA to implement new label directions and when?

It is still in the draft stage. But I think in the long term we are going to definitely implement changes in those label statements. We have to. In the short term we will probably try to change some of those label statement that are counter to good disposal management practices. But to make significant changes in the disposal statements in the future, we will have to publish guidelines or inform the registrants of what sort of data they will have to supply us to verify the value of that disposal statement or the effectiveness of it. So those guidelines will take probably a year, at least, to prepare and publish.

QUESTION:

Vendors, users and permit writers who want information on the relative merits of individual processes or combination of processes for a typical wastestream. What effects are being made to establish experimental design protocols or reporting procedures so that the evaluation of processes will yield a comparable basis rather than a confusion of dissimilar experiments? How about providing current researchers with an information scenario and getting them to develop practical solutions?

ANSWER - Bob Ehart:

I guess he wants to know what would be considered a standard mix. And just anybody might want to comment on that. Is that a possibility?

The only thing that I can think of that has an application is the fact that RCRA in their last amendments finally came up with an ability to allow for research and possibly as we go along there will be some standardization, some recognition of the needs for protocols and possibly in the future that type of thing.

It is definitely a very important question from the standpoint that the research that we see going on frequently is not done in a basis of allowing easy comparability. It is something that us black hatted people, who are trying to make sure that there are not any loopholes, need to know those kinds of issues. So I think it is a very appropriate one and possibly we can help the EPA wrestle with from the state perspective as well.

Any other comments on that?

COMMENT:

EPA has the power to control the waste container problem by making the manufacturer take back for refilling all containers. They are the ones who created the problem, let them solve it.

RESPONSE - Ray Krueger:

The industry has been very reluctant to even talk about that sort of thing. I have to agree that they have a good point from the standpoint of liability. Because they have no idea what has been done with that container after it goes out of their control. Difficult process to enforce.

QUESTION:

We continue to hear about agricultural chemical waste. Is there as much effort to find other generators, such as dry cleaners, garages, labs, hospitals, etc?

ANSWER - Bob Ehart:

I will take Matt's role on that one. Yes indeed there is and I think that the groundwater contamination issues are probably forcing the focus on a lot more of those particular issues as well. I think that in some ways the fact that some of the pesticide user industry people are interested in forming their own destiny, which is a very important factor, and the fact that the pesticide is not a major priority for solving problems on EPAs scale and list of their priorities means that it is these kinds of efforts that do identify problems, do create enforcement situations that maybe if we did not deal with them would not have immediately. But they are going to happen eventually and we are better off to handle it now than we are in the future. It is important to recognize that we are only a small piece of it and we are not a priority in some senses and we have to elevate that priority to solve our own dilemmas.

Roy Detweiler:

If there are no further questions, I would like to thank the panel for their work.

USERS' SUMMARY PANEL

Harold M. Collins, Jr., Panel Chairman
Executive Director
National Agricultural Aviation Association

Richard Byer
Director of Natural Resources and Safety
Louisiana Farm Bureau Federation

Robert M. Russell
Vice President, Government Relations
Orkin Pest Control

William T. Keane
Attorney at Law, Phoenix, Arizona

Roy Detweiler:

Our final panel presentation will be from the users of pesticides.

First is Harold Collins, Executive Director of the National Agricultural Aviation Association. He has had 18 years in sales and marketing with the pesticide industry and he has been two years as a research biologist in pesticides and of course he is at our headtable. Very instrumental in putting this meeting together from the very beginning and he is a good friend.

Next to him is William T. Keane who has the unusual credential of being an attorney, a PhD toxicologist, he also has a BS and MS in chemistry, he is chairman of the Arizona Trial Lawyers Association for six years and is currently their president. He has been appointed by the Arizona governor, Governor Babbit, to form a committee to recommend ways to minimize public exposure to pesticides and he is author of numerous articles and papers.

We also have with us Richard Byer, he is with the Louisiana Farm Bureau Federation, where he is Director of Natural Resources and Safety and he has been for the past twelve years. He lives in Baton Rouge, Louisiana. His areas of responsibility with the Farm Bureau ranges from tractor and farm machinery safety to pesticide safety. He is past president of the National Institute for Farm Safety, a member of the Ag Division of the National Safety Council and a board member of the Safety Council of Greater Baton Rouge.

Last, but not the least, is Robert M. Russell, who is Vice President, Government Relations with Orkin Pest Control in Atlanta, Georgia. His job responsibility is to contact state and federal officials to instruct in pest control, the regulations and coordination with the industry and also with congress. He advises his company on regulatory requirements.

With that I will turn it over to Harold Collins, panel chairman.

Harold Collins:

I just wanted to let the audience know, this morning, that this panel has been selected to give a representation of the user community since this workshop has been orchestrated to provide assistance to the user community and therefore we felt that this would be an appropriate time to critique what we think has been accomplished with the first and second National Pesticide Waste Disposal Conference.

I can tell you that for many years, users have felt a little bit like the boy that the parents had to tie a porkchop around his neck to get the family dog to play with him. We get real unpopular in some areas of the world. We want to do better. We need help to do better and I think the recommendations from this group, representing a wide range of users, applicators, perhaps can give direction to the future. I am most pleased with some of the direction that has been suggested by those presentations earlier throughout this week.

First we will start our panel with Dick Byer from the Louisiana Farm Bureau Federation.

Dick Byer:

Thank you Harold. If you looked at your program you saw the name Mark Maslyn on there. Mark is our man in Washington for the American Farm Bureau. Unfortunately Mark could not be here and I was asked to step in for him.

It is very difficult to speak for all farm bureaus, for all farmers, obviously. The point has been made, and well made, that regulations and rules should vary from state to state and local to local. Farmers and ranchers are the major users of pesticides and other chemical products that serve as production aids in modern agriculture. They are the final resting point for pesticides. We believe there is a commensurate responsibility that these products be used and disposed of in such a way that they pose no risk to the environment of which their neighbors, family and farms are a part in that fact. Unfortunately this seems to pass by a lot of people some times. Farmers are true environmentalists.

Agriculture is not much different than many other segments of society. The scope and understanding of the pesticide waste disposal problem ranges from the careful and the conscientious user to the uninformed or those that frankly do not care. I guess that we are really not that much different from other segments of society.

From that standpoint, we believe that there is a fundamental need for much more information addressing the problems and the potential risks, and what individual farmers and ranchers can and should do to address these issues. There is a strong need for user orientation. I have seen some presentations here in the last couple of days that were very much aimed in that direction. I have seen some that frankly would have left a lot of farmers still in a quandry.

In recent years there has been a growing appreciation at the farm level, of the problems associated with the disposal of pesticide wastes. Farmers need the how to's. How do I comply with the rules and regulations. How do I actually do what these laws say. Farm bureaus and state extension personnel and others, need to continue to address this need. Farmers need very specific information on the options available to them in disposing of the waste products and the product contianers. We would welcome the fact sheets that we heard mentioned from EPA, from manufacturers and others. And we would suggest that these be distributed as soon as possible and be geared to production agriculture.

There is a need to clarify the confusing and sometimes conflicting federal and state rules and regulations regarding the disposal of hazardous products. There needs to be more continuity, more conformity. We have talked about that the last several days and we firmly believe that.

We believe the subject of pesticide containers, and we think this is a big one, needs to be addressed. We believe these need to be addressed from the standpoint of all users. Whether they be commercial applicators, individual farmers and as it was mentioned this morning, or the homeowner who purchases pesticides. The lack of uniformity in the sizes, shapes and material of pesticide containers, also presents practical disposal problems and we have discussed that.

I would like to mention, coming from Louisiana, that we in that state have made great strides in eliminating much of the confusion. A lot of the conflicts between the various state and federal laws and regulations, through the efforts of people like Butch Calhoun, who was on a panel prior to this, and Darryl Rester, whom you have already heard from. We think that we have a pretty good working organization down there of Farm Bureau and Extension and the State Department of Agriculture and as Butch pointed out some pretty good understandings between our Department of Environmental Quality and our Department of Agriculture. We like having agricultural situations within the Department of Agriculture.

In conclusion, I would suggest that next year's program might feature a user panel made up of some farmers from around the country. These are the folks that will flat tell you, in a hurry, this works, this does not work, we like this, we do not like that. We think they could shed some real light on what is practical, what is realistic, and what is financially feasible.

Thank you.

Bob Russell:

Thank you. I guess I will have to throw away my first line, because I read on the program where I was going to be last. I thought well at least there is some distinction in being last even if there is no honor. But, I lost that.

It is certainly a pleasure to be here today with what I consider a very learned group, and to hear the available science of what we can do with pesticide waste disposal.

I represent the structural pest control industry and we do not, probably, measure up in as far as quality of pesticides are concerned. But in as far as applications are concerned, our industry probably makes something like half a million pesticide applications every day. So we certainly have some concerns in as far as the field of hazardous waste are concerned.

With the present state of the science, and the degree of regulation that is required, I really do not know whether to be frightened or frustrated or both. The requirements seem to be this, and the results that we have to obtain are this, and the way between one and the other is sometimes very very difficult for us to ascertain.

In structural pest control today we see three problem areas.

The first is in facilities for disposal. The second is the methodology of the land disposal that we can use at our branch or site locations. And the third is the degree of regulations that we must sustain.

First, I would like to say that our industry has a strong objective not to be generators of hazardous waste. We hope through full use and re-use to stay under the two hundred and twenty pounds per month, per location that would throw us into a small quantity generator. We would prefer to stay a very small quantity generator under that two hundred and twenty pounds.

We have run some tests, both for our company and for others in our industry, and we think that in most locations we now can do this. But we do not look at this as a static situation and we feel that we have got to look ahead and make sure that we consider the future probabilities.

As far as the land facilities are concerned, it is our understanding that there are now something like six hundred land facilities in the country. And I believe that EPA has advised that only about four hundred and ninety-two are certified for the RCRA requirements. So their preliminary estimate is that something like eleven hundred of these facilities may close. Our ability to use the remaining will thus be probably more expensive and therefore less convenient.

Also, some of these facilities now will not take our triple rinse containers. They just refuse to take them. And some of them will not take aerosol containers. And aerosol as a part of pesticide applications have become a very significant part of our technology.

Now, our methods for onsite disposal, other than the landfill, are very limited and expensive, at this time. I say this because many members of our industry are relatively small companies. The technology and the cost of the proposed or developing technology may be beyond their means to assimilate. So we need some kind of a backup and we hope at a reasonable level that our members can use at this level.

The degree of requirement is probably our most severe problem. And it could have been even worse had it not been for an EPA ruling that gave us the ability to dispose of rodenticide base, up to the two hundred and twenty pound level. Without this ruling our full use and re-use policy would be in jeopardy at our larger locations.

We have some concerns about truck wash rinse. It is our understanding that the aerial industry has secured an exemption on this and we hopefully would like to qualify for the same type exemption because the amount of rinse and the percentage of toxic in that rinse coming off of a truck is a very, very low level of a pesticide.

We have some concern about our sites or branch locations. These are places where we store chemicals, where we wash our trucks, and where we fill our pesticide tanks. Our sites are identical to thousands of commercial applicators all over the country and to hundreds of thousands of private applicators. We all have the same conditions that we have created over the years. This gives us some cause for concern because we really do not know exactly where we stand on these sites and what the future possibility may be.

Insurance is a problem for us. Premiums are up and they clause pollution and contamination, which is really the clause that would cover us in as far as hazardous waste situations are concerned, is being dropped out of the policies.

There was a recent bill in the Congress that I really liked. It did not pass. It was HR3418 by a freshman congressman out of New Hampshire. In this bill he set up a limitation on liability. If the operator involved would come forward and do the cleanup, and this bill would say that there would be some limitation on liability so that it could be carried no farther past his cost of the cleanup. I think somewhere legislatively, we have got to look at something like this. The cost of claims, the cost of settlements has continued to escalate and we are not alone. The insurance industry all over the country is having problems but that is a problem for us, in particular, because it is involved with our hazardous waste.

At this stage I think we need some kind of a cooperative compliance for us to get from this to here. There are no really clear roadmaps for us to negotiate that tortuous trail so we need some understanding as far as compliance is concerned. I hope perhaps that we can work out or work with some kind of a stage by stage progression in accordance with the science that we have at this time.

If there is a eminent hazard to health or to environment, we are going to get in and clean it up. We will do that. But if it is a potential hazard to health or environment, or not something that definitely establishes a danger, then we would hope that we could utilize some stage by stage progression and work the situation out while containing and preventing any further spread at the time.

Right now I see four short term objectives for our industry. The first is some provision of land facilities for our currently generated waste, both hazardous and solid. The second is control of waste being generated through management. Through management I am talking about our full use or re-use. In full use we want to make sure that we calculate the dose required for the job and try to use it all up. Always there is a small residue left that we use on that job but this has to be in compliance with the label. Also we hope that there can be some better science for on site control. Three, I hope that we can gain some cooperative compliance on the sites and the problems, which there does not seem to be any practical solution at this time. And four, I too, and it has been mentioned here earlier, would like to see the appointment of a state lead agency for the guidance and the regulation of all pesticides uses. And certainly there could be backup for knowledge here in both the land grant universities and USDA.

I think this conference has been interesting and informative and I really believe that it can be a beginning towards a direction of some type of a solution. I want to thank you very much for letting me be a part of this today.

Bill Keane:

It is indeed a pleasure to be with you here again, for a second year in a row and I would like to apologize at the outset for my relatively husky, broken voice. I am truly not a country western singer or a bouncer it is just that I have picked up a clasic case of strep throat and I apologize for that. In fact I guess that puts me in a unique position. This might be one of the few presentations I get to make in my life, where it is more painful for me to give it than it is for you to sit through it.

At any rate, the first thing I would like to do is thank all of you for attending. You know this is a unique mix of people we have here and all of you have come forward to try to solve the problems of ground and aerial applicators. I think the Dan Baker, luncheon speaker on Monday, was entirely appropriate for this group because he says you get the most enrichment out of life when you give to other people and help them solve their problems. That is what all of you have done. You have given of your talents and your expertise to try to solve the problems of ground and aerial applicators.

I had the distinct pleasure of being with you last year and I was asked to be here on behalf of the aerial applicators and my function last year was to try to summarize for you some of the problems that they felt they had and to outline for you what we thought our problems were.

I would like to look back over the last year, again through the eyes of the ground and aerial applicators and give you some idea of where I thought we have come and what some of our future problems might be and maybe what some of the solutions are.

Last year I stipulated at the outset that all applicators violated RCRA many times each year in doing their work. At the end of the 1985 program when I was on a summary panel, just like this, I informed all of you that the applicators were frustrated. We knew that we were confronted with RCRA, we knew we had to comply and we knew that the scientific techniques available to comply did not exist and we felt that the workshop had not provided those to us. We wanted immediate solutions and we are coming to the rash realization that immediate solutions are not readily available.

One year later, if you talk to the applicators, they are still frustrated. They still have all the same problems that we had before. I am not aware of one technique that has yet become commercial out of these meetings. Some of the solutions appear as though it is going to be many years of research before they will come to fruition. But having said that let me hasten to add that there is some guarded optimisim among applicators. We now perceive that the regulators and the researchers recognize the complexity and significance of the applicator problem. We see bright minds in research dollars being infused into this particular area. We know that lines of communication have been opened up among diverse groups that did not exist one year ago. Again, however. I must stress that many of the critical problems we have appear to have solutions that might take years to unfold. If research is not the immediate answer to our problems, then maybe an innovative regulatory approach may be the solution.

I heard some speakers recommend that the regulatory control of pesticide hazardous waste be shifted from RCRA to FIFRA. As an attorney, it is my opinion, that if properly implemented, the regulation of pesticide hazardous waste under FIFRA would be equivalent in effect to regulation under RCRA. And equivalent protection of man and the environment would result.

What other innovative regulatory approaches might yield more rapid solutions to our daily problems? Maybe EPA could develop various approved agricultural practices and once these approved agricultural practices are implemented by ground and aerial applicators, a rebutable presumption would exist of compliance. Now what am I really saying, let me give you a practical example of what I mean and let me lay some background or foundation for this example.

The one objective that I have heard mentioned here over and over again is that one, we should minimize the amount of rinsate and two, let's do what is necessary to prevent pesticides from impacting the soil.

One method of preventing pesticides from impacting the soil is to build concrete pads and above ground piping and above ground tanks to store rinsate to re-use it again on crops. Now if the

EPA would approve a blueprint for the construction of such a facility and if an applicator built such a pad, in compliance with that approved blueprint, a rebutable presumption would exist that he indeed was in compliance. In this manner, and if this went into effect, applicators would be given the security necessary before making these substantial financial expenditures to build these facilities and that have confidence that the agency would not change their minds six months or a year later, and conclude that this wasn't what was really needed, you have got to tear it all up and start again.

The things I am recommending suggest to me that regulators must be courageous and innovative in attempting to find solutions for some of these problems. Now I recognize and all applicators recognize that the EPA knows a lot more today about these problems than they did a year ago. We recognize that they are going to know a lot more about these problems five years from now, than they know today. But in the applicators opinion, this should not be used by regulators as an excuse for failing to take some bold innovative regulatory steps to solve these problems now.

Since I have just talked about cement pads and above ground tanks, let me give you one additional observation about tanks to store rinsate. I think that is a great idea and I am glad it works in Illinois and some of these other states but it appears to me that some of those states where it does work and has been tried have a mono-culture. I come from a state where we do not have a mono-culture. We have tried to sit down with some of the applicators and decide how many tanks we would have to have to store rinsate due to the large variety of crops that we spray. The answer is we are going to have to have fifteen, eighteen, twenty tanks sitting there and that just makes it prohibitive. Does it mean it is not a good idea, no. Does it mean we should not follow it up, no. What it may suggest is, this is another area where we need some innovative regulation that permits us to maybe condense those down at least for the rinsates for similar crops or the same crop. Rinsates containing pesticides for the same crop could all be put into the same tank.

Last year I told everyone in attendance that there was a lack of consistency in the interpretation of RCRA by regulators. This problem still exists and I want to give you an example. At this workshop some regulators have suggested that the way to contain rinsate is to build either tanks or surface impoundments that are in the ground and level with the ground surface. Yesterday in a meeting, an EPA regulator said just the reverse. He would never do that, he would always put them in above ground tanks. So here at a meeting, a year after, we have been addressing this problem for the first time. We are hearing different EPA people say different things. And if you are an applicator without a lot of scientific knowledge, and if you are not an engineer, and all applicators are not, you are getting mixed vibes. They do not know how to interpret those signals. I think by now that should have been resolved and EPA should be speaking with one voice. And I suspect that EPA would oppose the use of all concrete structures below ground level. And they would want all structures to store pesticides above ground.

One year ago when I stated that there was no uniformity of enforcement of regulations I gave some examples. Well it is still going on and I want to give one more. I have been informed that some companies that do business and have plants in more than one region, shop from region to region to get the most favorable interpretation of RCRA. Now most applicators operate in just one region and therefore they are denied this preference. They do not have the ability to farm shop. The moral to be derived from that example is that we need uniform regulations and uniform enforcement for all pesticide users. And I want to stress the word all.

Now I told you a year ago that even the best nozzles on ground rigs and aircraft used to spray pesticides indeed leak. They contaminate the soil and soil contamination is one of the biggest problems we have. In fact the biggest problem we have is the soil contamination that is built up over many years of use of this type of equipment. Now this is the best kind of equipment we can buy and even with the optimum maintenance the nozzles still leak and we still contaminate soil. That means if we clean up today, I am here to tell you, we are going to recontaminate tomorrow. We know it, we do not like it, but it is something we have to live with.

Now what I would like to do is encourage researchers to work on these kinds of nozzle problems. It would greatly assist us in preventing future contamination.

I would like to give you one last observation on this major problem of pesticide soil contamination. Last year applicators admitted that pesticides in soils had accumulated over many years of use and this was their major problem. The research reported last year and this year provided no immediate solution to that problem. That is the problem that is going to cost us millions and billions of dollars to clean up at each applicator's site. That is the problem that is going to put each applicator out of business. At the EPA workshop in Cincinnati I was fortunate enough to be asked to attend that. It was likewise concluded that there were no immediate engineering solutions to that problem. So last year and this year I recommended a solution to the problem by spreading that contaminated soil on existing farmland. And by analogy, if we are now recommending, and that is what we have done at this meeting, that rinsate containing pesticides can be applied to that farmland why can't soil containing those pesticides, at similar concentrations, be applied to the same farmland. If what we are doing is regulating pesticides chemicals why should it make any difference that they are in rinsate or soil at the time they are applied to farmland.

At the EPA workshop in Cincinnati, in July 1985, when it was concluded that research had no answer to solve this problem, one EPA employee concluded that maybe a three to five year moratorium should be imposed in the enforcement of RCRA on these soil contaminations alone. On just the limited, well circumscribed problem. This would grant researchers, such as many of you in the audience, adequate time to do the job that you have started on to solve that problem. This type of approach of a moratorium on citing applicators for contaminated soil might be another example of a courageous and innovative regulator approach required to address this momentous problem.

In conclusion, I guess I would just say, when you talk to applicators they would agree that as a result of these two workshops we have come a long way baby. But indeed we still have a long way to go. Thank you very much for your attention.

Harold Collins:

One of the nice things about attending a conference like this is that you get enough smart people and they say everything that needs to be said. The next trick, I guess, is implementation of the things that were said, to make things possible, to make us able to comply with the law. I guess from another applicator point of view you have done good and we need to do gooder, if you will pardon the expression.

We would like to see, as many have spoken here, uniform regulation of all users with regard to disposal. If you took, and I have been corrected on the pronunciation of this by our association president, Stan Jones, the Ogalala reservoir, or aquifer, it extends from Canada down to Texas. There are many many users of pesticides in that geographical area, including commercial applicators who are indeed regulated, including farmers who are exempt, including homeowners, who have really no controls, and including government, who has wide use of pesticide. When and if a material, the presence of a chemical, might show up in an aquifer, what is its source? I think all of us would agree that all of us need to take every effective action we can to preclude the presence of chemicals in areas where they are not wanted. And remember too, that I am carefully avoiding the word contaminant. I am talking about the presence of chemical. Looking in the dictionary, the word contaminant is a red flag, it means bad. The presence of chemical is not necessarily bad and I think we need to be careful of the words we use because sometimes we are terribly misinterpreted, particularly by persons who do not have the time to spend, as you and I do, devoting our lives to these kinds of problems.

Uniform regulation, we think, is necessary and will go a long way toward creating the public awareness that is needed to keep our health and environment in as safe a condition as we can possibly do.

Number two, we need acceptable methods to minimize, eliminate and handle these pesticides wastes. A moratorium, as Bill Keane has suggested, is indeed a consideration. Particularly in light of historical problems over which we had no control. We lacked the scientific knowledge and expertise to know we were creating a problem and we have since enacted legislation that says it is bad and we are in some cases punishing the wrong person. Indeed what we end up doing is a money hunt. We are looking for someone to pay a bill for something that was done before anyone knew it was not good. We need to look at these situations. Let's let science catch up. Science does wonderful things. Our society is as good as it is because of science.

We need to take some calculated risks. As Phil Kearney said, I believe last year, if not he said it to me sometime this year, we have become a society of "what if's." "What if" is indeed the realm of a scientist and we benefit from that but we can have too many "what if's" and we would end up doing nothing. If we took every precaution nothing would ever get done. The best thing to do is the status quo. We are not in that situation. Whatever we do it must be affordable, efficient, and it must be practical within what we now know is the state-of-the-art.

Number three. I think we need to begin directly to modify the regulatory inadequacies. This will have to involve the commercial, the private, the farmer and the urban citizen. Because we currently we have an inability to comply with the law and that has been described to you fully. The law' the statute currently contains section 19 in the FIFRA which provides the administrator with the authority to deal with disposal of pesticide materials. The fact that some pesticides are currently regulated under RCRA should not be a major problem because it is the same administrator of the Environmental Protection Agency who is responsible for the implementation of both laws. That is merely then an administrative challenge and I think working together a group like this can accomplish this.

The pesticide label will have to play a part in the matter of disposal. At this point in time, I believe I am correct in saying that when a person does something inappropriate it may only be prosecuted, at least from the point of view of the law, if it is on the label. Now that is dealing with pesticides under FIFRA. So I think we need to work very hard at the proper language, recognizing our limitations of something that could address the problem. To punish those who wantingly violate the label or health or environmental situations and yet provide a measure or protection for those who are doing their very best. And certainly their very best within the tools you have provided us.

We need further uniformity among the federal regulators. It has come to pass in the last few years that because of the lack of uniformity, those of us who are in the business of worrying about things can shop among various segments of the federal entity, for the best answer and then get that one on paper and put it to work. That has some benefits but I think it has more dangers. And so I think we need to stress more and more uniformity in the concerns. We need more time on how to regulate rather than what to regulate. All too often someone will pick a chemical and then it is totally misinterpreted. And I would site one example that occurred this past year. This was a media presentation. There was a chemical that was put on watermelon in California that allegedly created a problem. It made people ill. This is very inappropriate. We all agree to that. But we blamed the chemical. The chemical had nothing to do with it. It was the misuse of the chemical. Someone inappropriately used it and therefore they should feel the full burden and responsibility for that action. So let's be careful what we blame and let's worry about how to regulate everything. Let's not get so detailed on one particular thing. Let's look at the overall issue.

Recognize there are 35,000, approximately, registered chemical products, probably involving 1,200 active ingredients. We can not work on each of those individually considering the length of time it would take to come up with definitive information. There is a level of risk here. But certainly pesticides are among the most tested chemicals known to man. In order to obtain a registration for a pesticide product it must go through elaborate and ever changing questions. And a registrant who successfully gets a product on the market today will probably be asked next year for an entirely new package of information that no one had thought about before and it is what if kind of situation. So let's deal with real problems and let's get a little bit away from some of the conjecture that really does not address the day to day real life activities. We fully support, we continue to support the localization of information. We have members in our industry who are contacted by as many as five levels of state government, essentially all asking the same question. And more important, all essentially involved in the same process. The attempt to protect human health and the environment. We would like to funnel all of that, as Bob Ehart suggested last year, it is an innovative idea on his part and many others have mimicked since, let's get the state lead agency and/or the land grant university and/or USDA as the place for people to go to ask questions about us. This communication system has been in effect for many many years, it is effective, it has worked. American farm production is a classic example of that communication system. Anyone who wants information from it, we would like them to go there for it. The information in many cases, already existed and we are asked to duplicate. We need to stop some duplication.

Another problem with this is that because of various enforcement groups putting these issues among various regulatory agencies we complicate the problem and we confuse the user community, we throw up our hands and we do not know what to do. By localizing, by centralizing, I think you will find we will very readily comply and will participate with you.

Finally, I am very impressed with Bill Keane's statement regarding the rebutable presumption. I think that the user community could support this concept so that we will fall within the regulatory scheme with things like pads or tanks, so that we are not considered inadequate or that we are illegal doing something. Rather we have time to do the best we can for now and adapt later but recognize there are finite financial resources available to permit us to construct something and learn only a month, a year later that that is no longer adequate. So there is part of the challenge, will someone give us the permission to be able to expend funds and have some assurance that we will continue in compliance over the reasonable life of whatever it is we are expected to do.

This would provide for an automatic permitting. This is a very interesting idea, and would be allowed if we shifted some of the administrative out of RCRA and into FIFRA. I think, as Bill has suggested, it does provide an opportunity for equivalent protection and I think even more important it might be very politically desirable.

Finally, I would like to challenge the group here. I think that all of you are to be commended for your interest. I think we now need to get together and implement the thoughts and ideas in a very formal way with full cooperation. By doing so we will reduce the confusion out there. But more important, we need to reassure the public that there is an effort being made and that the bad bad things that are constantly being thrown toward them can be reduced.

How many times, for example, have you seen the media run out to the airport and interview the captain of a 747 airline that just landed successfully and ask how did you do that. Rather they would go interview the observer of the crash or the survivor. So let's take a more positive approach on this issue as well. I would like to challenge you to take a more advocacy role. Let's help educate more than us, let's spread the message out to other people, they too have good ideas. And let's assure them that there are risks. There are things we do not know but we are indeed being positive at this time. I think the education concept is an answer and I would encourage you to do one final thing. There are applicator organizations national in scope with regional locations. I would like all of you to take opportunity at some point in each year and attend their state, regional or national meetings. Visit with these folks. I think they are another source of information. These are the people who are on the day to day firing line. They can give you even more indepth if not colloquial descriptions of their problems.

Finally, I would like to take this opportunity to thank a gentleman who has busted his back and is very very effective do not know of any other time we are going to get away with it. Roy Detweiler, he has brought this conference to this position in two years of a lot of hard work and I sure hope if we continue into the future that Roy's leadership will be a part of it and I would like to thank him personally.

As one final thought. Again going back to the user attitude. I would compare Winston Churchill with the user community and Lady Astor who hated his guts with the other side of the fence. On one occasion Lady Astor was known to have said to Winston Churchill, "if you were my husband, I would put arsenic in your coffee." To that Mr. Churchill replied, "if you were my wife, I would drink it." Thank you.

QUESTIONS AND ANSWERS

QUESTION for Bill Keane:

The first question deals with the issue of EPA approved facilities. If EPA would approve site construction and/or equipment, when the real problem actually be in the operation, how would operators be assured of appropriate operation?

ANSWER:

I agree, that is a problem. That one has not been solved yet. Let me tell you why I have suggested and recommended this. Some years ago, regulators told applicators in Texas that the way to handle rinsates was to dig a surface impoundment. Some of those were bulldozed out of the ground, some of them were lined with plastic, some of them were lined with concrete. Subsequently those same regulators came back and said now you have just created a major problem. How do we know you did not leak down to the groundwater table. We have defined it not to be a tank but a surface impoundment so therefore you must sink wells, you must monitor your groundwater, you must monitor for every pesticide you have ever applied on your property. Now let me give you another example. Let's not kid each other. What is happening to rinsate today? It is going on the ground. And what if an applicator calls me and says Bill, give me some legal advice. What can I build today with some degree of assurance, that it will be legal five, ten years from now. It in itself, will not be declared hazardous waste and I will not have to dig it up and transport it to a permitted landfill. The answer to him is I cannot give you any advice. I can give you some technology, I can give you what some of the engineers are talking about, I can tell you what sounds good, what looks good, but I can not give you any guarantees.

Last year we told you that the average applicator in the United States had one and a half aircraft and had one and a half pilots. That is the size of the industry we are dealing with. They can not afford to build a facility and two or five years down the road tear it out and start over again. I think Bob Ehart said it more eloquently than I ever could. We have to bite the bullet and we have to do something that looks like a reasonable solution to the problem. Cement pads, above ground tanks. I think we ought to do it. Could there still be misuse of that? Sure. Could citations result? Sure. If they do not burn it up, if they do not have cement or concrete curves and they splash over in the soil, sure there is a problem. But I think we just have to move forward and solve this problem with pesticides on the soil.

QUESTION for Bill Keane:

The next question. It is really a question for everybody on the panel. Could anyone on the panel say how much a user might be willing to pay for disposal, particularly the price per gallon of the liquid waste?

ANSWER:

From my standpoint, the answer is no. The reason is this. Over the last five years I have seen applicators' businesses change dramatically. They are much more cautious trying not to create hazardous waste, they are more cautious not to create excess rinsate so that the volume that we need to treat continually is being reduced and as that goes down, I suspect with that minimal volume that is left over, the amount that we are willing to pay to get it treated could continually rise and it would still be appealing to applicators. I do not know if anyone else on the panel wants to address that.

COMMENT:

With respect to surface impoundments, they are regulated by RCRA but indeed if you just develop above ground tanks and you want to re-use that pesticide you do not need a permit.

ANSWER - Bill Keane:

That is exactly true. It falls under the farmer exemption in RCRA and indeed that is one of the reasons why I think many of the people at this meeting said look, let's create the cement pad, the above ground tanks for the rinsate and let's re-use it because no permits are required. If you get a surface impoundment then you must apply for a permit. Most people can not produce permits to give to themselves. They incur a substantial amount of engineering and scientific consulting fees and it is a long drawn out process and then and only then does your paper work really begin. Because once you are permitted for a permitted facility there are copious amounts of records you must keep. I think the goals of applicators are not to become permitted facilities. We do not want to be permitted.

QUESTION for Harold Collins:

Why doesn't industry sponsor milk runs? They could do this instead of complaining about the government not solving a problem. That is industry's responsibility.

ANSWER:

Well I think, number one, we are trying to take a noncomplaining mode. We are trying to draw attention to the problems we are facing so we can maintain our businesses. I think there has been a clear demonstration of a much broader communication between government, user, state regulatory, research community, land grant, university. So I see progress going and I think we are still asking, as most people always do, when we have a problem, we would like someone to assist us when we are incapable of it.

QUESTION for Bob Russell:

I applaud your efforts at waste minimization. Given the small business size of your members, the type of products you use, to assure your members tend to be concentrated in urban areas, is it reasonable to allow even two hundred and twenty pounds per month in a local landfill? For example, ten applications in the field is ten to twelve tons of fairly toxic materials going to a landfill not prepared for such compounds. Wouldn't a better approach be to never take them to a landfill?

ANSWER:

I am frustrated again. When I mentioned a number of applications, many of those are a very small quantitiy of chemicals. It may be only a quart of chemical in a residential application and I do not think that too many of our chemicals go into the landfills right now. I am just not sure that the problem that seems to be in vision there is a problem that we have.

Anybody else want to comment on that. Harold.

ANSWER - Harold Collins:

In addition to any accumulated waste from a commercial operation, I wonder if anyone has ever also evaluated the amount of homeowner pesticide purchase. Again not necessarily restricted chemicals because I think all of these should be treated as heavy weights, all chemicals. Has anyone evaluated how much, in an urban situation, is used in part and then disposed of to the landfill. What quantity of active ingredient are we talking about coming from the homeowner population. This may be more significant than that is coming from the commercial operation. We cannot answer it but I think it does need some consideration.

QUESTION for Harold Collins and Bill Keane:

Would you address regional differences in pesticide use with regional regulations and/or does your call for uniform regulations fail to address regional differences in use, soil hydrology, and environmental impacts.

ANSWER - Harold Collins:

First of all the federal government has transferred regulatory responsiblity to states so that they must paint a broad brush picture of implementation of the statute. We do know and there are indeed substantial differences in pesticide use. For example, our people will have a work season of six weeks in the Dakotas and that is the total time that an aerial applicator has to work. On the other hand, those in the valley of Texas, Southern California, Florida will work essentially twelve months out of the year. If you consider these aerial operator locations which are located in Florida, where you stick a shovel in the ground and you get water at the bottom of the shovel, versus in the high plains of Texas where you are sitting on top of 2,000 feet of caliche, we do have substantial differences that need to be recognized and I believe that I would share Butch Calhoun and Bob Ehart's comments with their need to implement and meet the regional or localized needs. So I do not think there is a broad brush approach for all things but I think that is the role the state can play.

QUESTION:

Here is one that goes along with uniformity. Users group is asking for uniformity in regulations but EPA says uniformity is not possible because each state can set its own guidelines. What is going to happen, who's idea will win out?

ANSWER - Bill Keane:

....lobbying before legislatures. There is tremendous variability as to what laws any particular state will pass. On this particular topic or any other topic. There is no question that there are going to be difficulties in getting uniformity. At this stage of the game when we are dealing about group interpretations of some of the most simple issues, I think there should be uniformity at least within the various regions of EPA. And I give you examples where that is indeed not occurring. When we get down to the state level there is not going to be uniformity from state to state and I think that each one of us are going to have to work that out in front of our state legislatures and indeed our state regulators on a case by case basis and a state by state basis. But one last thing, I find, at least in my state, that many of the state regulators lean heavily, at this stage, on the interpretations of RCRA given to them by EPA. I have been told that region 9 says you do it this way, so my state has adopted region 9's position. I am finding out that region 8 does it a different way. Why didn't my state adopt region 8's position. If we had consistency of EPA interpretation, and the state is leaning heavily on their advise and guidance, I think we would have much more uniformity in the states.

QUESTION for Bill Keane:

The next is a technical issue, but it is addressed to you, since you are a chemist and toxicologist. I am sure you can handle it. It says if you take contaminated soil and put it out over farmland for disposal how do you handle a soil that contains a mixture of pesticides which may not be compatible with the crop. For example, in pesticides and herbicides, if you spread it out on farmland would it require monitoring to know what is happening.

ANSWER:

It is a broad statement. You cannot land spread all pesticides. Some of them would be incompatible to crops. So the bottom line is you obviously, number one, have to analyze the contaminated soil, find out what is in it and then find out what crop the grower intends to use the field for and then you would have to spread that pesticide containing soil across that field at a concentration level or a deletion level that would be similar/identical to the concentration that you are spraying on there. So we are talking about a micro-thin layer. It can be done, we have done it in some similar situations before RCRA was passed. Then you would have to monitor the pesticides in that particular farmers field. To see how rapidly they have degraded. The better solution, of course, is fallowed ground or non-agricultural ground, and you heard one example by Mr. CalhoUn, that they are using state ground. Which is fallowed ground. So you do not have to apply it, necessarily, to the farmers ground, but yes, I agree, you would have to do all of the monitoring.

COMMENT:

Just a suggestion to everyone, why not a new superfund to solve the problem contributed to by users, manufacturers and regulatory agencies. Another comment. I think a product should not be allowed on the market until the manufacturer can supply a neutralizing agent. No one knows the chemistry better than the manufacturer. Give the manufacturers five years to comply or remove their product from the market. No one is asked to comment.

RESPONSE - Bill Keane:

Certainly when you list a product, the approved degradation of this material may not be applicable for the mixture so you are back to where you started from.

This is a request for technology that really did not exist at the time that the product was originally formulated. The rules of the game have changed.

Many applicators have approached me and said, why cannot a registrant when he manufactures the chemical attach to the outside of the container a little packet. And that packet could be antidote, if you will, or the metabilizing agent, so that when done applying the chemical we dump, or throw this little biodegradable packet into our hopper, it neutralizes everything in the system and what comes out is not any longer hazardous waste. Well, obviously that is the magical answer. That is the optimum solution to the problem, but I do not think chemistry is going to permit us to do that with a wide variety of chemicals, pesticides, or chemical molecules we use for pesticides.

COMMENT:

Here is testimonial or comment from the people in the back of the room. Has Bill Keane ever considered seeking the appointment to head of EPA. If not, would he consider running for president. Either position would permit him to solve the problems of this conference with his common sense solutions. Do not put him in the empty bus seat, we need him.

With that I want to thank you for coming. Let's give this panel a hand. We hope for future support when we decide what to do next. Thank you very much.

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